

Appendix A

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1. Introduction

Since the proposal of the first regulations under the Resource Conservation and Recovery Act (RCRA) in 1978, mineral processing wastes have been subject to a different regulatory framework than most other categories of potentially hazardous wastes. In the 1978 proposed rule implementing Subtitle C of RCRA, EPA introduced the "special waste" concept, which was based on the belief that these "special wastes" should, on a provisional basis, be regulated less stringently than other wastes because they were produced in very large volumes, were thought to pose less of a hazard than other wastes, and were generally not amenable to the management practices required by the technical standards being proposed for other hazardous wastes.

In 1980, Congress made this "special waste" concept a statutory requirement when it enacted the Bevill Amendment as part of the 1980 amendments to RCRA. The Bevill Amendment temporarily exempted fossil fuel combustion wastes, oil and gas field production wastes, mining and mineral processing wastes, and cement kiln dust waste from potential regulation as hazardous wastes under Subtitle C of RCRA.

This Appendix provides a summary of the history of the Federal Mining Waste Exclusion, from the initial enactment of RCRA through the present.

2. The Resource Conservation and Recovery Act and Proposed Subtitle C Regulations (1976 - 1980)

On October 21, 1976, Congress enacted the Resource Conservation and Recovery Act (Pub. L. 94-580). Section 3001 of RCRA mandated that the EPA Administrator "promulgate regulations identifying characteristics of hazardous waste, and listing particular hazardous wastes which shall be subject to the provisions of this subtitle." Section 3004 required the Administrator to promulgate standards applicable to owners and operators of hazardous waste treatment, storage, and disposal facilities. Congress did not explicitly address the regulation of mining and mineral processing wastes, but Section 8002(f) instructed the EPA Administrator to conduct:

...a detailed and comprehensive study on the adverse effects of solid wastes from active and abandoned surface and underground mines on the environment, including, but not limited to, the effects of such wastes on humans, water, air, health, welfare, and natural resources..."

This study requirement was based upon the Congressional recognition that mining wastes were generated in larger quantities than any other type of solid waste, and that historical and, perhaps, contemporary mining wastes management practices, could pose danger to human health and the environment. Mandated study factors included sources and volumes of wastes generated, present and alternative disposal practices, potential danger posed by surface runoff and fugitive dust emissions, the cost of waste management alternatives, and the potential for use of discarded materials as secondary sources having mineral value. The House report (No. 94-1491) accompanying the RCRA bill indicates that the focus of EPA's inquiry was to be the environmental and technical adequacy of current waste management practices, with economic practicality being a secondary consideration.

On December 18, 1978, EPA proposed its regulations for managing hazardous wastes under Subtitle C of RCRA (43 FR 58946). These proposed regulations introduced the "special wastes" concept. "Special waste" referred to wastes

that were generated in large volumes, were thought to pose less risk to human health and the environment than other hazardous wastes, and for which the proposed technical requirements implementing Subtitle C might not be appropriate. EPA identified mining wastes as one of six such "special wastes" under the proposed regulations.¹ EPA proposed to defer most of the RCRA Subtitle C requirements for these special wastes until information could be gathered and assessed that would enable EPA to regulate them with special standards.

In the fall of 1979, EPA completed a draft background document that outlined the development of EPA's methodology for determining which materials qualified as "special wastes" (Introduction and Criteria for Special Waste, November 2, 1979, EPA Docket # A-D1-SS0062). The background document presents the eight criteria that were used to develop the original list of "special wastes" for the December 18, 1978 proposed Subtitle C regulations:

1. Limited information on waste characteristics;
2. Limited information on the degree of human health and environmental hazard posed by disposal;
3. Limited information on waste disposal practices and alternatives;
4. Very large volumes and/or large number of facilities;
5. Limited movement of wastes from the point of generation;
6. Few, if any, documented damage cases;
7. Apparent technological difficulty in applying current Subpart D² regulations to the waste because of volumes involved at typical facilities; and
8. Potential high economic impact if current Subpart D regulations are imposed.

The background document states further that criteria 1, 2, 3, 4, and 7 were the driving forces in the decision-making process for the 1978 proposed Subtitle C regulations, while the other criteria were met to some degree for individual wastes.

EPA received many public comments on the proposed Subtitle C regulations. The background document indicates that the Agency incorporated many of these comments, as well as its own continuing analysis, when it revised the criteria used to designate "special wastes." The concluding section discussed the four criteria that EPA, at that point, intended to use to evaluate petitions to designate a waste as a "special waste:"

1. The waste is or is anticipated to be generated and disposed in large volumes. This determination would be based on the national volume generated per year; the projected volume of waste generated over the next decade; the volume of waste disposed at a typical disposal facility; and extraneous siting restrictions on the generator.
2. The waste should be uniform, i.e., the waste exhibits the same characteristics whenever disposed, and is amenable to being predominantly managed without being mixed with other wastes.

¹ The other five "special wastes" were cement kiln dust waste; utility waste; phosphate rock mining, beneficiation, and processing waste; uranium mining waste; and gas and oil drilling muds and oil production brines.

² 40 CFR Part 250, Subpart D contained the proposed RCRA Section 3004 management standards (43 FR 59008). These requirements are now found in final form at 40 CFR Parts 264-266).

3. The waste must pose only a low potential hazard to human health and the environment. This determination would be based on the class of hazard of the waste; the chemical composition and physical characteristics of the waste; results of the application of 40 CFR 250 Subpart A [now 40 CFR Part 261] procedures for determining hazardous characteristics and other available testing information (although ignitable, corrosive, or reactive wastes would be acceptable as special wastes at the discretion of the Administrator); and information on documented past damage cases.
4. Due to lack of information on current treatment, storage, and disposal practices and alternatives, the Agency would be unable to propose standards for control of the waste.³

Using the revised list of four criteria, the Agency considered expanding the list of six "special wastes" in the 1978 proposed Subtitle C regulations to a total of eleven:

1. Cement kiln dust waste;
2. Utility waste;
3. Phosphate mining, beneficiation, and processing waste;
4. Uranium mining waste;
5. Wastes from the extraction, beneficiation, and processing of ores and minerals other than phosphate rock and uranium ore;
6. Gas, oil, and geothermal drilling and production wastes;
7. Shale oil industry wastes;
8. Red muds [from bauxite refining];
9. Black muds [from bauxite refining];
10. Coal mining waste; and
11. Dredge spoils.

Though the special waste category was never promulgated, it is clear that EPA was responsible for amplifying the original study requirement under RCRA 8002(f) into a regulatory concept, that the Agency had several specific criteria (principally low hazard, high volume, and infeasibility of Subtitle C technical requirements) that it employed to evaluate potential special wastes, and that the group of wastes that might have received the temporary exemption from full Subtitle C regulation was to be both finite and relatively small.

3. Final Subtitle C Regulations and the Solid Waste Disposal Act Amendments of 1980, including the Bevill Amendment (1980)

Throughout 1980, Congress was conducting hearings to substantially amend RCRA. On February 20, 1980, Rep. Thomas Bevill (AL) offered an amendment which, among other things, amended section 3001 to temporarily exempt three categories of waste from Subtitle C regulation:

1. Fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels;
2. Solid waste from the extraction, beneficiation, and processing of ores and minerals, including phosphate rock and uranium ore; and
3. Cement kiln dust waste.

These wastes were to remain exempt from Subtitle C regulation until completion of the studies required under Sections 8002(f) and 8002(n)(p), the latter of which was to be added to RCRA (these sections are discussed below).

³ EPA also considered and rejected a number of criteria not included in the original list, including: adequacy of current waste management practices, and resource recovery potential.

From his statements before the Committee on Interstate and Foreign Commerce, it is apparent that Rep. Bevill offered his amendment primarily to prevent regulatory disincentives for the development of the nation's coal resources. Rep. Bevill stated that "the House [would] not allow EPA to take steps that will discourage the use of coal." Rep. Bevill noted that EPA "has very little information on the composition, characteristics, and degree of hazard posed by these [i.e., coal] wastes" and that the Agency believed that any potential hazards presented by the materials are relatively low.

Rep. Bevill also claimed that existing Federal and State regulation would sufficiently regulate wastes from the combustion of coal and other fossil fuels while EPA was undertaking the required studies. During the hearing, several other representatives spoke in favor of the Bevill Amendment, specifically concerning refuse-derived fuel (Rep. Horton-NY), fly ash and slag from coal (Rep. Findley-IL), oil and gas muds and brines (Rep. Moffett-CT), and large volume coal wastes (Rep. Rahall-WV; Rep. Staggers-WV). Rep. Florio (NJ) submitted for the record results of EPA studies that documented the known health risks associated with radioactive uranium and phosphate wastes.

The discussion of mining wastes as a part of the Bevill Amendment was limited to brief comments by Rep. Williams (MT), who stated that wastes from mineral production should not be subject to Subtitle C regulation at that time. As an example of the limited potential hazard of these wastes, Rep. Williams paraphrased a National Academy of Sciences study, stating that slag waste generated by the smelting of copper

...is basically inert and weathers slowly. The slag produced 2,500 years ago at King Solomon's mines north of Eliat, Israel, has not changed perceptibly over time.

Rep. Williams then continued

Should wastes such as smelting slag be subject to stringent regulations at this time? I think not-not until a thorough study is conducted by the responsible agency which clearly proves the need for additional regulation. [Emphasis added.]

Based on Rep. Bevill's comments, it is apparent that the fundamental purpose of the amendment was to limit the impact of Subtitle C regulation on the coal industry (the Senate version of this bill, however, emphasized oil and gas field production wastes), at a time when the nation and the Congress were extremely concerned about energy self-sufficiency. Although the Bevill Amendment, as read into the record during the hearing, explicitly refers to mineral processing wastes, Rep. Bevill did not mention these wastes or respond to Rep. Williams' statements.

Almost all of the major components of the Bevill Amendment were originally conceived by EPA. The Bevill Amendment made the Agency's planned activities, as expressed in the 1978 proposed Subtitle C regulations and the 1979 "Special Waste" background document, statutory requirements. In fact, with very few exceptions, all of the specific provisions of the Bevill Amendment were lifted (often verbatim) from EPA rulemakings and related documents.

Furthermore, it is clear from the legislative history that the Bevill Amendment was designed to defer regulation of those wastes which EPA had defined as special wastes. Congressman Bevill referred specifically to EPA's 1978 special waste proposal in his explanation of the amendment, noting that EPA had asserted

it did not have data on the effectiveness of current or potential waste management technologies or the technical or economic practicability of imposing its proposed regulations. In the same [12/18/78] announcement, EPA also stated that it believed that any potential hazards presented by the materials are relatively low.

126 Cong. Rec. 3361 (1980). Other Congressmen also referred to the Bevill wastes in terms of the EPA "special waste" concept. Congressmen Santini, Staggers, and Findley all supported the amendment on the basis that it would defer regulation of "special wastes" until EPA had completed the required study. Id. at 3348, 3349, 3363, 3365. Congressman Williams of Montana, in explaining why smelting slag should be studied (see above), noted that the Bevill Amendment "would direct [EPA] to evaluate certain high volume, low toxicity wastes so as to assure a reasoned set of regulations by which to manage these wastes." Id. at 3364. Clearly, the discussions on the floor of the House imply Congressional intent to incorporate the "special waste" concept into the Bevill Amendment definitions of excluded wastes. (See also 852 F.2d at 1327).

On May 19, 1980, EPA promulgated final regulations under Subtitle C of RCRA which addressed, among other things, "solid waste from the extraction, beneficiation, and processing of ores and minerals" (45 FR 33066). In promulgating these regulations, EPA decided to withdraw rather than finalize the "special waste" category. The Agency's stated basis for this decision was twofold:

1. The thresholds for the (EP) extraction procedure toxicity and corrosivity characteristics tests (which are used to identify hazardous wastes subject to Subtitle C regulation) had been significantly relaxed. As a result, the number of wastes in general, and "special wastes" in particular, that would be potentially subject to Subtitle C regulation was greatly reduced.
2. The Agency had incorporated more flexibility, through phasing and standard-setting, in Parts 264 and 265 (which contain the regulations for permitted and interim status owners/operators of hazardous waste facilities). Thus, a RCRA permit writer had the ability to take into account site-specific environmental characteristics and management practices (i.e., "special waste" study factors) in establishing permit requirements.

As a result, the Agency concluded that these changes "accomplish the objectives of, and eliminate the need for, a special solid waste category." When EPA eliminated the "special waste" concept, it was aware of Congress' intention to exempt mining and mineral processing and other proposed "special" wastes from Subtitle C regulation because passage of the Solid Waste Disposal Act Amendments of 1980 (including the Bevill Amendment) was expected (Senate and House versions had been passed on June 4, 1979 and February 20, 1980, respectively).

On October 12, 1980, Congress enacted the Solid Waste Disposal Act Amendments of 1980 (Pub. L. 96-482), which added section 3001(b)(3)(A)(ii) (the Bevill Amendment) to RCRA. This section temporarily prohibits EPA from regulating, among other wastes, "solid waste from the extraction, beneficiation, and processing of ores and minerals, including phosphate rock and overburden from the mining of uranium ore" as hazardous waste under Subtitle C of RCRA until at least six months after EPA completes and submits to Congress the studies required by Section 8002(f), and by Section 8002(p), which was also added to RCRA by the 1980 amendments. Section 8002(p) required the Administrator to study the adverse effects on human health and the environment, if any, of the waste from the disposal and utilization of "solid waste from the extraction, beneficiation, and processing of ores and minerals, including phosphate rock and overburden from the mining of uranium ores," and submit a Report to Congress on its findings by October, 1983. The 1980 amendments also added section 3001(b)(3)(C), which requires the Administrator to make a regulatory determination, within six months of the completion of the section 8002 studies, whether to regulate the studied wastes under Subtitle C of RCRA.

On November 19, 1980, EPA published an interim final amendment to its hazardous waste regulations to reflect this mining waste exclusion (45 FR 76618). The regulatory language incorporating the exclusion was identical to the statutory language, except EPA added the phrase "including coal." In the preamble to the amended regulation, however, EPA tentatively interpreted the exclusion to include "solid waste from the exploration, mining, milling, smelting, and

refining of ores and minerals." The preamble made it clear that the Agency was interpreting the scope of the exclusions very broadly within the context of the mining industry, and that, over the next 90 days, EPA intended to review the legislative history of the Bevill Amendment and the public comments received in response to the interpretation. The preamble indicated that based on this review, EPA would probably narrow the scope of the exclusion.

4. Litigation, the Hazardous and Solid Waste Amendments of 1984, and Bevill Exclusion Reinterpretations (1981 - 1988)

As noted above, the Solid Waste Disposal Act Amendments of 1980 amended section 3001 to require the EPA Administrator to make a regulatory determination regarding the wastes temporarily excluded from Subtitle C regulation within six months of submitting the required Report to Congress. EPA was required to submit the Report to Congress by October, 1983. In 1984, the Concerned Citizens of Adamstown and the Environmental Defense Fund sued EPA for failing to complete the section 8002 studies and the regulatory determination by the statutory deadlines (*Concerned Citizens of Adamstown v. EPA*, No. 84-3041, D.D.C., August 21, 1985). EPA explained to the District Court for the District of Columbia that the Agency planned to propose to "reinterpret" the scope of the mining waste exclusion so that it would encompass fewer wastes. Therefore, EPA suggested two schedules to the court: one for completing the section 8002 studies and submitting the Report to Congress, and one for proposing and taking final action on the reinterpretation. On August 21, 1985, the court ordered EPA to meet these two schedules; first, the Agency was to complete the section 8002 studies and Report to Congress by December 31, 1985, and to publish the regulatory determination by June 30, 1986; and second, EPA was to propose to reinterpret the Bevill exclusion and subsequently, to take final action on the proposed reinterpretation by September 30, 1986.

EPA submitted the Report to Congress on December 31, 1985. The Report to Congress provided information on sources and volumes of waste, disposal and utilization practices, potential danger to human health and the environment from mining practices, and evidence of damages. EPA focused on the mining industry segments that produced and/or concentrated metallic ores, phosphate rock, or asbestos.

On July 3, 1986, EPA issued its regulatory determination for the mining wastes covered by the Report to Congress (51 FR 24496). The regulatory determination concluded that Subtitle C regulation of the wastes studied in the Report to Congress (i.e., extraction and beneficiation wastes) was not warranted at that time. This conclusion was based on EPA's belief that aspects of the Subtitle C standards were likely to be environmentally unnecessary, technically infeasible, or economically impractical when applied to mining waste. EPA announced its intention to develop a program for mining waste under Subtitle D of RCRA.

The July 3, 1986 regulatory determination was subsequently challenged in court (*Environmental Defense Fund v. EPA*, 852 F.2d 1309 (D.C. Cir. 1988)). The Court of Appeals upheld EPA's regulatory determination for extraction and beneficiation wastes.

In the interim, Congress enacted the Hazardous and Solid Waste Amendments to RCRA in 1984. These amendments added new requirements applicable to owners and operators of facilities that treat, store, or dispose hazardous waste, and included minimum technical standards for the design, construction, and operation of waste management units, land disposal restrictions, and corrective action requirements for continuing releases. In developing these new requirements, Congress considered their feasibility with respect to and potential impact on the management of certain categories of wastes. This concern was embodied in what was to become Section 3004(x) of RCRA, the so-called "Simpson Amendment," which allowed the EPA Administrator to modify the Subtitle C technical standards for managing mining wastes, utility waste, and cement kiln dust waste, as long as protection of human health and the environment was assured.

In the floor debate on the Simpson Amendment, the Senate considered remarks concerning the types of wastes that would be eligible for the special status conferred by the amendment. Sen. Jennings Randolph (WV) read into the record the description of mining wastes that was contained in the committee report on the HSWA amendments. In this report, "solid wastes from mining and mineral beneficiation and processing" are described as "primarily waste rock from the extraction process, and crushed rock, commonly called tailings..." The report continues by stating

[t]he 1980 amendments covered wastes from the initial stages of mineral processing, where concentrations of minerals of value are greatly increased through physical means, before applying secondary processes such as pyrometallurgical or electrolytic methods. Smelter slag might also be included... These wastes were considered "special wastes" under the 1978 proposed regulations as being of large volume and relatively low hazard. [Emphasis added.]

The remaining discussion in the excerpt from the committee report focuses on the potential difficulties of managing the huge volumes of waste rock and tailings associated with mineral exploitation under the new minimum technology standards under debate.

Thus, although the Congress explicitly considered the special study wastes in crafting the provisions of HSWA, there is nothing in either the amendments themselves or in the legislative record supporting them to suggest that Congress construed the term "mineral processing" broadly, i.e., to include wastes that are not "special wastes."

In keeping with its agreement in the *Adamstown* case, on October 2, 1985, EPA proposed to narrow the scope of the Bevill exclusion (50 FR 40292). In preparing the proposed mining waste exclusion, EPA implicitly applied the "high volume, low hazard, special waste" concept from EPA's 1978 proposed hazardous waste regulations. The proposed rulemaking would have eliminated from the mining waste exclusion most wastes from the processing of ores and minerals; EPA proposed to retain bauxite refining muds, phosphogypsum from phosphoric acid plants, and slag from primary metal smelters and phosphorus reduction facilities within the Bevill exclusion. In the preamble, EPA stated that Congressional intent supported the Agency's special waste concept. The proposed rule did not, however, outline the criteria that EPA used to determine high volume or low hazard.

In response to the proposed reinterpretation, many commenters "nominated" additional wastes that they believed fit the "special waste" criteria, and therefore should also be excluded from Subtitle C regulation as "processing wastes." Because EPA had not explicitly defined the terms "high volume" or low hazard" in the October 2, 1985 proposal, the Agency was unable to determine the regulatory status of these nominated wastes. EPA could not infer definitions for these terms based upon the four wastes listed in the proposal as meeting the "special waste" criteria. The public comments on the proposal and the Agency's analysis indicated that the proposed reinterpretation could not be finalized because it did not set out "practically applicable" criteria for distinguishing "processing" (i.e., high volume, low hazard ore and mineral processing residuals) from non-processing wastes (i.e., non-excluded) wastes. Moreover, the Agency was unsure whether such criteria could be developed. Therefore, faced with the court-ordered deadline for final Agency action in *Adamstown*, EPA withdrew the proposal on October 9, 1986 (51 FR 36233). As a consequence, the interpretation of the mining waste exclusion established in the November 19, 1980 rulemaking notice remained in effect.

The Agency's decision to withdraw its proposed reinterpretation of the mining waste exclusion was subsequently challenged in court (*Environmental Defense Fund v. EPA*, 852 F.2d 1316 (D. C. Cir. 1988), cert. denied 109 S. Ct. 1120 (1989) (*EDF v. EPA*)). In this case, the petitioners contended, and the Court of Appeals agreed, that EPA's withdrawal of its proposed reinterpretation of the Bevill Amendment was arbitrary and capricious because it reaffirmed an "impermissibly over-broad interpretation" of the Bevill Amendment. *EDF v. EPA*, 852 F.2d at 1326.

In reaching this decision, the Court found that the words "waste from ... processing of ores and minerals" do not convey a self-evident, accepted meaning. Id. at 1327. Therefore, the Court reviewed the structure and the legislative history of the Bevill Amendment to ascertain the intent of Congress. The Court found that "[t]he structure of the Bevill Amendment suggests that the term 'solid waste from the . . . processing of ores and minerals' should be interpreted in a manner consistent with the concept of large volume wastes." Id. The Court also decided that "[t]he legislative history of the Bevill Amendment establishes that the key to understanding Congress's intent is the concept of 'special waste' articulated in the regulations proposed by EPA on December 18, 1978 following the enactment of RCRA." Id. See 43 FR 58911 (1978) and 50 FR 40293 (1985).

In explaining this decision, the Court cited statements made by members of Congress during the legislative consideration of the exclusion and the description of the provision in the Conference Report accompanying the legislation. Based on these indications of Congressional intent, the court concluded that

it is clear that Congress did not intend the mining waste exclusion to encompass all wastes from primary smelting and refining. On the contrary, Congress intended the term "processing" in the Bevill Amendment to include only those wastes from processing ores or minerals that meet the "special waste" criteria, that is, "high volume, low hazard" wastes. 852 F.2d at 1328-29.

Thus, when the Agency withdrew its October 2, 1985, proposed reinterpretation of the mining waste exclusion, which was based on implicit "special waste" criteria, EPA by default reverted to its November 19, 1980, interpretation of the exclusion, which did not distinguish between high volume, low hazard processing wastes and other processing wastes. As a consequence, the number of temporarily excluded processing wastes remained very large. The Court ruled that this result was inconsistent with Congressional intent. Therefore, the Court ordered EPA to propose, by October 15, 1988, a specific list of mineral processing wastes that meet the criteria of high volume and low hazard, and thus remain temporarily excluded from Subtitle C regulation. 852 F.2d at 1331.

5. Final Reinterpretation of the Mining Waste Exclusion (1988-1990)

In compliance with this Court decision, on October 20, 1988 EPA published a proposal to further define the scope of Section 3001(b)(3)(A)(ii) of RCRA. (See 53 FR 41288.) In the October 20, 1988 proposal, EPA presented a criterion for defining mineral processing wastes and a two-part criterion for identifying which mineral processing wastes are high volume; however, the Agency proposed to defer judgment on the hazard posed by high volume mineral processing wastes until preparation of a required Report to Congress. The Agency also applied the processing and volume criteria to its available data on mineral processing wastes, and identified 15 wastes which it believed met the criteria, and which the Agency therefore proposed to retain within the exclusion and study for the Report to Congress:

1. Slag from primary copper smelting
2. Process wastewater from primary copper smelting/refining
3. Blowdown from acid plants at primary copper smelters
4. Bleed electrolyte from primary copper refining
5. Slag from primary lead smelting
6. Blowdown from acid plants at primary zinc smelters
7. Process wastewater from primary zinc smelting/refining
8. Red and brown muds from bauxite refining
9. Phosphogypsum from phosphoric acid production
10. Slag from elemental phosphorus production
11. Iron blast furnace slag
12. Air pollution control dust/sludge from iron blast furnaces
13. Waste acids from titanium dioxide production
14. Air pollution control dust from lime kilns
15. Slag from roasting/leaching of chromite ore.

Based on comments received on the October 20, 1988 NPRM and further analysis, EPA decided that significant changes in the proposal were necessary before a final rule establishing the boundaries of the Bevill exclusion for mineral processing wastes could be promulgated. Accordingly, on April 17, 1989, the Agency published a revised proposed rule that contained a modified high volume criterion, clarifications to the definition of mineral processing, and for the first time, an explicit low hazard criterion. As stated in the April notice, EPA believed that such a criterion is required in order to identify those mineral processing wastes that are clearly not low hazard and, therefore, not "special wastes" even if they are high volume.

In the April NPRM, the Agency also proposed to remove from the Bevill exclusion all but 39 mineral processing wastes, many of which were "nominated" in public comment on the October NPRM. Of these 39, six wastes were believed at that time to satisfy all of the "special waste" criteria described in the proposal:

1. Slag from primary copper smelting
2. Slag from primary lead smelting
3. Red and brown muds from bauxite refining
4. Phosphogypsum from phosphoric acid production
5. Slag from elemental phosphorus production
6. Furnace scrubber blowdown from elemental phosphorus production.

The other 33 wastes were proposed to be conditionally retained within the exclusion, because they are mineral processing wastes that the Agency believed satisfied the volume criterion articulated in the proposal but for which the Agency did not have adequate data to evaluate compliance with the proposal's new hazard criterion. Thus, the following 33 wastes were judged, based in many cases upon information submitted in public comment, to have generation rates that might exceed 50,000 metric tons per year per facility, and therefore, be potentially eligible for continued exclusion under Bevill:

1. Barren filtrate from primary beryllium processing
2. Raffinate from primary beryllium processing
3. Bertrandite thickener sludge from primary beryllium processing
4. Process wastewater from primary cerium processing
5. Ammonium nitrate process solution from primary lanthanide processing
6. Roast/leach ore residue from primary chrome ore processing
7. Gasifier ash from coal gasification
8. Cooling tower blowdown from coal gasification
9. Process wastewater from coal gasification
10. Bleed electrolyte from primary copper refining
11. Process wastewater from primary copper smelting/refining
12. Slag tailings from primary copper smelting
13. Calcium sulfate wastewater treatment plant sludge from primary copper smelting/refining
14. Furnace off-gas solids from elemental phosphorus production
15. Process wastewater from elemental phosphorus production
16. Fluorogypsum from hydrofluoric acid production
17. Air pollution control dust/sludge from iron blast furnaces
18. Iron blast furnace slag
19. Process wastewater from primary lead smelting/refining
20. Air pollution control scrubber wastewater from lightweight aggregate production
21. Wastewater treatment sludge/solids from lightweight aggregate production
22. Process wastewater from primary magnesium processing by the anhydrous process
23. Process wastewater from primary selenium processing
24. Process wastewater from phosphoric acid production
25. Wastes from trona ore processing

26. Basic oxygen furnace slag from carbon steel production
27. Leach liquor from primary titanium processing
28. Sulfate processing waste acids from titanium dioxide production
29. Sulfate processing waste solids from titanium dioxide production
30. Chloride processing waste acids from titanium and titanium dioxide production
31. Chloride processing waste solids from titanium and titanium dioxide production
32. Blowdown from acid plants at primary zinc smelters
33. Process wastewater from primary zinc smelting/refining.

All other waste streams from mineral processing were proposed to be removed from the exclusion. Most of the remaining streams were low volume; three high volume wastes were proposed for removal on the basis of hazard: acid plant/scrubber blowdown from the primary copper, lead, and tin sectors.

On September 1, 1989 (see 54 FR 36592), EPA provided the final Bevill exclusion criteria. The September 1 rulemaking also finalized the Bevill status of five mineral processing waste streams. EPA temporarily retained these wastes within the Bevill exclusion for study in the July 1990 Report to Congress:

1. Slag from primary copper processing
2. Slag from primary lead processing
3. Red and brown muds from bauxite processing
4. Phosphogypsum from phosphoric acid production
5. Slag from elemental phosphorus production.

In addition, the Agency modified the list of mineral processing wastes proposed for conditional retention in April 1989. In the September 1 rulemaking, the Agency conditionally retained 20 mineral processing wastes within the Bevill exclusion:

1. Roast/leach ore residue from primary chromite production
2. Gasifier ash from coal gasification
3. Process wastewater from coal gasification
4. Calcium sulfate wastewater treatment plant sludge from primary copper processing
5. Slag tailings from primary copper processing
6. Furnace off-gas solids from elemental phosphorus production
7. Fluorogypsum from hydrofluoric acid production
8. Process wastewater from hydrofluoric acid production
9. Air pollution control dust/sludge from iron blast furnaces
10. Iron blast furnace slag
11. Process wastewater from primary lead production
12. Air pollution control dust/sludge from lightweight aggregate production
13. Process wastewater from primary magnesium processing by the anhydrous process
14. Process wastewater from phosphoric acid production
15. Basic oxygen furnace and open hearth furnace air pollution control dust/sludge from carbon steel production
16. Basic oxygen furnace and open hearth furnace slag from carbon steel production
17. Sulfate process waste acids from titanium dioxide production

18. Sulfate process waste solids from titanium dioxide production
19. Chloride process waste solids from titanium tetrachloride production
20. Slag from primary zinc processing.

All other mineral processing wastes that were not conditionally retained were permanently removed from the Bevill exclusion as of the effective date of the September 1, 1989 rule (March 1, 1990 in non-authorized states), subjecting these wastes to RCRA Subtitle C regulation if they are solid wastes and exhibit one or more of the characteristics of hazardous waste as defined in 40 CFR Part 261.

On September 25, 1989 (54 FR 39298), EPA reevaluated the status of the 20 conditionally retained wastes. Applying the high volume and low hazard criteria contained in the September 1, 1989 final rule, the Agency proposed to permanently remove seven mineral processing wastes from the Bevill exclusion and retain 13 other mineral processing wastes within the exclusion for study in the Report to Congress.

On January 23, 1990, a final rule established the status of the 20 mineral processing wastes which were proposed either for removal from or retention in the Bevill exclusion in the September 25, 1989 notice of proposed rulemaking (NPRM); fifteen of these wastes were retained in and five wastes were removed from the exclusion by this notice. In addition, the rule contained technical corrections to the September 1, 1989 final rule. Furthermore, the January final rule promulgated a clarification to the definition of "designated facility" that the Agency proposed on September 25, 1989.

The January final rule completed EPA's rulemaking process regarding the RCRA status of mineral processing wastes until the completion of the required Report to Congress and Regulatory Determination. In establishing the final Bevill status for these 20 mineral processing wastes, the Agency considered information presented in public comment on the September 25 proposal together with additional analysis of previously collected EPA industry survey and field data and, where appropriate, modified the decisions made in the September 25 proposal.

As in the September 25 proposal, the Agency evaluated the 20 mineral processing wastes by applying the high volume and low hazard criteria contained in the September 1, 1989 final rule, using a three-step process. First, the Agency applied the high volume criterion to the available waste generation data. For each waste, the Agency obtained facility-specific annual waste generation rates for the period 1983-1988 and used the highest average annual facility-level generation rate in calculating the sector-wide average. Mineral processing wastes generated above the volume criterion thresholds (an average rate of 45,000 metric tons per facility for non-liquid wastes, and 1,000,000 metric tons for liquid wastes) passed the high volume criterion.

In the second step, the Agency evaluated each of the 20 wastes with respect to the low hazard criterion using the relevant waste characteristics. EPA considered a waste to pose a low hazard only if the waste passed both a toxicity test (Method 1312) and a pH test.

The third step involved consolidating the results from the first two steps to determine the appropriate Bevill status of the 20 conditionally retained mineral processing wastes. Applying these criteria, the Agency removed the Bevill exclusion for the following five mineral processing wastes:

1. Furnace off-gas solids from elemental phosphorus production
2. Process wastewater from primary lead processing
3. Air pollution control dust/sludge from lightweight aggregate production
4. Sulfate process waste acids from titanium dioxide production
5. Sulfate process waste solids from titanium dioxide production.

The following 15 mineral processing wastes were retained within the exclusion (in addition to the five already retained in the September 1 rule), pending preparation of this Report to Congress and the subsequent Regulatory Determination:

1. Treated residue from roasting/leaching of chrome ore
2. Gasifier ash from coal gasification
3. Process wastewater from coal gasification

4. Calcium sulfate wastewater treatment plant sludge from primary copper processing
5. Slag tailings from primary copper processing
6. Fluorogypsum from hydrofluoric acid production
7. Process wastewater from hydrofluoric acid production
8. Air pollution control dust/sludge from iron blast furnaces
9. Iron blast furnace slag
10. Process wastewater from primary magnesium production by the anhydrous process
11. Process wastewater from phosphoric acid production
12. Basic oxygen furnace and open hearth furnace air pollution control dust/sludge from carbon steel production
13. Basic oxygen furnace and open hearth furnace slag from carbon steel production
14. Chloride process waste solids from titanium tetrachloride production
15. Slag from primary zinc processing.

The January rule also contained technical corrections to the September 1, 1989 final rule. The Agency's review of the final rule, as well as public comments, revealed slight differences between portions of the regulatory language and the corresponding discussion in the preamble. As a result, the January rule included minor editorial changes to the language of the September 1 final rule.

The January rule established the boundaries of the temporary exclusion from hazardous waste regulations for mineral processing wastes provided by RCRA Section 3001(b)(3)(A)(ii). All 20 mineral processing wastes for which the Bevill exclusion has been retained have been subject to detailed study in this Report to Congress.

Appendix B

EPA Data Collection Activities

Appendix B-1

**Description of the 1989 National Survey of
Solid Wastes from Mineral Processing
Facilities (SWMPF Survey)**

Appendix B-1

Description of the 1989 National Survey of Solid Wastes from Mineral Processing Facilities (SWMPF Survey)

In order to be fully responsive to the individual study factors provided in Section 8002(p) of RCRA, EPA needed to obtain information that specifically pertained to the facilities, processes, and management practices that are associated with the ore and mineral processing wastes that are covered by the Mining Waste Exclusion. Accordingly, in February of 1989, EPA administered a written questionnaire to the operators of all facilities that, to the Agency's knowledge, generated one or more of the ore and mineral processing waste streams that the Agency was, at that time, considering retaining within the Exclusion. The survey consisted of approximately 300 questions, and was distributed to the operators of about 200 mineral processing facilities.

EPA requested that a person who was knowledgeable about the waste management practices utilized at the particular facility provide written answers to the questions in the survey, and submit these responses to the Agency. EPA then analyzed these data, and has used them to respond to the requirements of RCRA Section 8002(p) in preparing this report. In particular, the data collected allowed the Agency to address the sources and volumes of the excluded wastes (study factor 1), current and alternative waste management practices (study factors 2 and 5), costs of alternative waste management practices (study factor 6), and potential danger to human health and the environment (study factor 3).

Data necessary to evaluate documented cases of danger (study factor 4), current and potential utilization of ore and mineral products (study factor 8), and potential impacts of waste management alternatives on the use of mineral resources (study factor 7) were developed through other sources (primarily intensive literature reviews, state contacts, and the U.S. Bureau of Mines).

The questionnaire was divided into nine sections. A description of each section, the types of information that it was designed to elicit, and the uses of the information obtained thereby is presented below:

- Section 1 - General facility information. This section requested information on the owner, operator, location, and operating status of the facility. In addition, this section contained questions that addressed the proximity of the facility to sensitive environments. Responses to these questions allowed EPA to verify important background data, and enabled the Agency to perform screening-level analyses of potential risk to human health and the environment, as well as to collect financial data needed for economic impact assessment.
- Section 2 - Processing units that generate a special waste. The questions in this section pertained to the specific points in the production process at which the special wastes were and are generated. The emphasis of the section was on gaining knowledge of how, where, and why these materials are generated. Respondents were asked to describe all on-site processes that generate each waste of concern. One duplicate set of questions was provided in an appendix to the questionnaire.
- Section 3 - Processing units that receive a special waste (or its residue). This section sought information on on-site operating units that utilized one or more special wastes as feedstocks, and produced final or intermediate products (i.e., materials of value). This information was also used to characterize current and alternative waste management practices. In particular, this section enabled EPA to evaluate the extent to which some of the special wastes are indeed handled as in-process feedstocks rather than wastes, as a number of facility operators and industry trade associations have claimed.

- Section 4 - Wastewater treatment plants that receive a special waste (or its residue). The questions in this section pertained to the specific practices that were employed in on-site wastewater treatment plants to manage special wastes. (These operations are sufficiently different than other types of waste management units to justify addressing them separately.) Questions pertained to capacity, treatment technologies employed, residues generated, and the fate of each of these treatment residues. This information was utilized to evaluate current, and especially, alternative waste management practices.
- Section 5 - Surface impoundments that receive a special waste (or its residue). The content and format of this section mirrored that of section 4, except that the questions were specifically oriented toward the characteristics of surface impoundments, a major waste management technology employed in the mineral processing industry. Once again, the nature of surface impoundments differs significantly from other waste management unit types; hence, for clarity, these units were addressed in their own section.
- Section 6 - Other waste management units that receive a special waste (or its residue). This section contained a series of questions that pertained to all other specific management practices that are applied to the special wastes and their treatment residues. This information is vital to EPA's understanding of the extent to which current industry practice is adequate to prevent releases of contaminants to the environment. In addition, EPA estimated the costs of these contemporary management practices to provide a baseline against which the costs of regulatory alternatives are compared. Again, an additional copy of some questions was provided in an appendix, so that the respondents could clearly and unambiguously describe all waste management units that handle a special waste and its residues.
- Section 7 - Environmental monitoring near waste management units. This section contained questions that addressed important environmental variables and any environmental monitoring that facility operators are conducting. Responses were used to assess actual and potential environmental contamination arising from the current practices used to manage special wastes.
- Section 8 - Waste management units not covered in sections 5 and 6. The questions in this section were in some instances similar in content to those in sections 5 and 6, but focused on any additional waste management units that do not receive or generate any special wastes or residues of special wastes. This information is required to assess the likelihood that documented or potential environmental contamination episodes are due to the improper management of wastes that are outside of the scope of the Report to Congress and to assess the potential need to conduct corrective action.
- Section 9 - Follow-up information. This final section simply requested the name, title, address, and telephone number of a person whom EPA could contact if clarification of the information provided to the Agency by the respondent was required.

Appendix B-2

**Description of 1989 EPA Sampling and
Analysis Activities**

Appendix B-2

Description of 1989 EPA Sampling and Analysis Activities

This appendix provides a summary of the EPA mineral processing waste sampling and analysis activities conducted during 1989 in support of rulemaking activities and preparation of this report. It includes brief descriptions of the background, objectives, and scope of the sampling effort, the methodology used to select candidate facilities, and the facilities that EPA sampled. The results of the sampling effort as they relate to the wastes covered by this report are presented in the supporting public docket (F-90-RMPA-FFFFF).

Background

Section 8002(p) of the Resource Conservation and Recovery Act (RCRA) requires EPA to study the adverse effects on human health and the environment, if any, from the disposal and utilization of "solid waste from the extraction, beneficiation, and processing of ores and minerals, including phosphate rock and overburden from the mining of uranium ore," and submit a Report to Congress on its findings. Section 3001 of RCRA excludes these wastes from regulation under Subtitle C of RCRA, pending completion of the study called for in section 8002(p). These provisions are collectively often referred to as "the Mining Waste Exclusion." Since 1980, EPA has interpreted the language of Section 8002(p) to include "solid waste from the exploration, mining, milling, smelting, and refining of ores and minerals" (45 FR 76618).

In response to the decision of the Court of Appeals in Environmental Defense Fund v. EPA, 852 F.2d 1316, D. C. Cir., 1988 (EDF v. EPA), EPA proposed (53 FR 41288, October 20, 1988) to narrow the scope of the Mining Waste Exclusion such that only 15 specific mineral processing wastes would be addressed in the study required by RCRA §8002(p); other mineral processing wastes were proposed to become subject to RCRA Subtitle C regulations if they exhibit one or more characteristics of hazardous waste. The 15 wastes proposed for study were distinguished from other mineral processing wastes based on the fact that they are generated in large volumes.

Based on public comments on the proposal and additional analysis, EPA subsequently proposed that mineral processing wastes to be studied be "low hazard" as well as "large volume." (See 54 FR 15316, April 17, 1989.) In the April proposal, EPA proposed to include six wastes within the scope of the §8002(p) study and indicated that the Agency needed more data to determine whether 33 additional wastes that met the proposed "high volume" criterion were also "low hazard" and, thus, would also be included in the study.

Objectives

The primary objective of collecting and analyzing mineral processing waste samples was to obtain the knowledge of the physical and chemical characteristics of the wastes that was needed to aid in determining which large volume wastes are "low hazard." The secondary objective was to provide information for use in evaluating the Section 8002(p) study factors for the required Report to Congress.

Scope

The types of wastes covered by the sampling and analysis effort were determined based on the Agency's April 17, 1989 proposal noted above. Specifically, the types of wastes covered by the sampling effort included: (1) the 33 types of waste proposed for conditional exclusion from RCRA Subtitle C requirements pending collection of information needed to determine if they are "low hazard"; (2) the three large volume wastes that the Agency proposed to remove from the exclusion because they were believed not to be "low hazard"; and (3) additional large volume wastes identified in

B-2-2 Appendix B-2: EPA Sampling and Analysis Activities

public comments on the proposed rule. The 33 wastes proposed for conditional exclusion on April 17, 1989 were as follows:

- ▼ barren filtrate from primary beryllium processing;
- ▼ raffinate from primary beryllium processing;
- ▼ bertrandite thickener sludge from primary beryllium processing;
- ▼ process wastewater from primary cerium processing;
- ▼ ammonium nitrate process solution from primary lanthanide processing;
- ▼ roast/leach ore residue from primary chrome ore processing;
- ▼ gasifier ash from coal gasification;
- ▼ cooling tower blowdown from coal gasification;
- ▼ process wastewater from coal gasification;
- ▼ bleed electrolyte from primary copper refining;
- ▼ process wastewater from primary copper smelting/refining;
- ▼ slag tailings from primary copper smelting;
- ▼ calcium sulfate wastewater treatment plant sludge from primary copper smelting/refining;
- ▼ furnace off-gas solids from elemental phosphorus production;
- ▼ process wastewater from elemental phosphorus production;
- ▼ fluorogypsum from hydrofluoric acid production;
- ▼ air pollution control dust/sludge from iron blast furnaces;
- ▼ iron blast furnace slag;
- ▼ process wastewater from primary lead smelting/refining;
- ▼ air pollution control scrubber wastewater from lightweight aggregate production;
- ▼ wastewater treatment sludge/solids from lightweight aggregate production;
- ▼ process wastewater from primary magnesium processing by the anhydrous process;
- ▼ process wastewater from primary selenium processing;
- ▼ process wastewater from phosphoric acid production;
- ▼ wastes from trona ore processing;
- ▼ basic oxygen furnace slag from carbon steel production;
- ▼ leach liquor from primary titanium processing;
- ▼ sulfate processing waste acids from titanium dioxide production;
- ▼ sulfate processing waste solids from titanium dioxide production;
- ▼ chloride processing waste acids from titanium and titanium dioxide production;
- ▼ chloride processing waste solids from titanium and titanium dioxide production;
- ▼ blowdown from acid plants at primary zinc smelters; and
- ▼ process wastewater from primary zinc smelting/refining.

The 3 large volume wastes that EPA proposed to remove from the mining waste exclusion because they are not "low hazard" were:

- ▼ acid plant and scrubber blowdown from primary copper processing;
- ▼ acid plant blowdown from primary lead processing; and
- ▼ air pollution control scrubber blowdown from primary tin processing.

Additional large volume wastes identified in comments on the proposed rule and included in the sampling effort were:

- ▼ basic oxygen furnace and open hearth furnace air pollution control dust/sludge from carbon steel production;
- ▼ open hearth furnace slag from carbon steel production;
- ▼ process wastewater from hydrofluoric acid production, and
- ▼ sulfate leach residue from primary copper processing.

Samples of each of these 38 types of waste¹ were collected at the point of waste generation from at least two facilities (except for waste types that are only generated by a single facility) because this was the minimum amount of data needed to implement the proposed "low hazard" criterion. In addition, EPA sampled the following five wastes, for which the Agency proposed on April 17, 1989 to retain the exclusion, where these wastes were generated at facilities that were visited for sampling of the 38 wastes listed above:

- ▼ slag from primary copper smelting;
- ▼ slag from primary lead smelting;
- ▼ phosphogypsum from phosphoric acid production;
- ▼ slag from elemental phosphorus production; and
- ▼ furnace scrubber blowdown from elemental phosphorus production.

One additional waste for which the Agency proposed to retain the mining waste exclusion, red and brown muds from bauxite refining, was not sampled because sampling visits to the facilities that generate this waste were not otherwise required.

In general, the wastes were also sampled "as managed" (e.g., after treatment or disposal) to provide information that could be used in the assessment of potential danger to human health and the environment for the Report to Congress.

Selection of Facilities for Sampling

Based on information provided by the U.S. Bureau of Mines, state agencies, and public comments received on the October 20, 1988 and April 17, 1989 proposed rules, EPA developed a list of the facilities in the United States that were thought to generate one or more of the 38 large volume mineral processing wastes identified for sampling. This list of facilities defined the universe of facilities from which individual facilities were selected for sampling.

¹ No primary tin processing facilities were in operation at the time the sampling was conducted, so air pollution control scrubber blowdown from primary tin processing was not sampled. In addition, basic oxygen furnace slag and open hearth furnace slag from carbon steel production were subsequently combined and considered to be a single waste type, though both were sampled separately. As a result, the number of mineral processing wastes discussed here as identified for sampling is 38 rather than 40.

EPA selected facilities for sampling from this list using the following procedure:

- Step 1. Select facilities for sampling that generate any of the 38 wastes that are generated by only one or two facilities. This step resulted in the selection of 15 facilities in eight commodity sectors² that generate 18 types of waste that are generated by two or fewer facilities. Three of the 15 selected facilities (in the copper sector) also provide for collection of at least two samples of each of three additional waste types.³ Thus, this step provides for sampling of 21 of the 38 wastes.
- Step 2. Select facilities randomly from the ten commodity sectors⁴ that have three or more facilities that generate one or more of the other 17 wastes, such that each of the 17 wastes can be sampled at two or more facilities. For each commodity sector, EPA generated three random numbers (between 0 and 1) using a Lotus 1-2-3 random number generator and multiplied each of the three numbers by the number of facilities in the commodity sector. The product of the first random number and the number of facilities in the sector, rounded off to the next highest whole number, was the number of the first facility chosen for sampling.⁵ The second number was the number of the second facility chosen for sampling. If the first two facilities selected both generated all of the wastes generated by the sector that needed to be sampled (exclusive of wastes covered in step 1 above), then selection of facilities for sampling in the sector was complete. If not, then a third (or additional) facility was selected in the same way until each waste could be sampled at at least two facilities. This step resulted in the selection of 22 facilities for sampling.

Following completion of this site selection procedure, data from the "National Survey of Wastes from Mineral Processing Facilities" became available that indicated that several facilities on the initial list of facilities selected for sampling did not generate one or more of the wastes that EPA planned to sample at the facility. In these cases, the next random number for the sector was used to select an alternate facility for sampling. Similarly, telephone calls to selected facilities that EPA made to collect information needed to plan the sampling visits sometimes led to the conclusion that a facility needed to be deleted from the sampling frame. In these cases, the next random number for the sector also was used to select an alternate facility for sampling.

Facilities Selected for Sampling

The 37 facilities that were selected for sampling based on the procedures described above are listed in Exhibit B-2-1. Of these 37 facilities, only 27 facilities generate one or more wastes that are covered by this report. These 27 facilities are identified with asterisks in Exhibit B-2-1.

² Beryllium, cerium/lanthanide, chrome ore, coal gasification, copper, magnesium, molybdenum, and titanium.

³ It is also the case that the two facilities selected for sampling of sulfate process wastes from titanium ore processing generate the chloride process wastes that also needed to be sampled. However, these facilities do not use the predominant chloride process or feedstocks, so additional facilities were selected for sampling.

⁴ Elemental phosphorus, hydrofluoric acid, iron/steel, lead, copper, lightweight aggregate, phosphoric acid, soda ash, titanium, and zinc.

⁵ For example, if 0.4467 is the first random number generated and there are 4 facilities in the commodity sector, the second facility was the first facility selected for sampling [$0.4467 \times 4 = 1.7868$, rounded up to the nearest whole number is 2].

Exhibit B-2-1
Mineral Processing Facilities Sampled By EPA
For The Report To Congress

Commodity Sector	Facility
Beryllium	Brush Wellman Co., Delta, UT
Cerium/Lanthanides	Molycorp, Inc., Louviers, CO Molycorp, Inc., York, PA
Sodium Dichromate	Occidental Chemical Corp., Castle Hayne, NC* American Chrome and Chemical, Corpus Christi, TX*
Coal Gasification	Dakota Gasification, Beulah, ND*
Copper	ASARCO Inc., Hayden, AZ* Kennecott Utah Copper, Bingham Canyon, UT* Magma Copper Co., San Manuel, AZ* Cypress, Casa Grande, Casa Grande, AZ
Elemental Phosphorus	FMC Corp, Pocatello, ID* Stauffer Chemical, Mt. Pleasant, TN*
Hydrofluoric Acid	Allied-Signal Corp, Geismar, LA* Pennwalt Corp., Calvert City, KY*
Iron/Steel	Sharon Steel Corp., Sharon, PA* USX, Lorain, OH* USA, Fairless, PA* USX, Braddock, PA* Bethlehem Steel, Sparrows Point, MD*
Lead	ASARCO, East Helena, MT* ASARCO, Glover, MO* Doe Run Company, Herculaneum, MO*
Lightweight Aggregate	Northeast Solite Corp., Mount Marion, NY Arkansas Lightweight Aggregate, W. Memphis, AR
Magnesium	Magnesium Corp. of America, Salt Lake City, UT*
Molybdenum	Climax Molybdenum, Fort Madison, IA
Phosphoric Acid	IMC, Mulberry, FL* CF Industries, Plant City, FL*
Soda Ash	Stauffer Chemicals, Green River, WY Tenneco, Green River, WY
Titanium Tetrachloride	du Pont, Pass Christian, MS* du Pont, Edgemoor, DE* Kemira, Savannah, GA* SCM, Baltimore, MD* Timet, Henderson, NV*
Zinc	Zinc Corp. of America, Monaca, PA* Zinc Corp. of America, Bartlesvill, OK

* Indicates facilities included within the scope of the Report to Congress.

Appendix B-3

List of Facilities With Documented Cases of Damage from Mineral Processing Waste

Appendix B-3

List of Facilities With Documented Cases of Damage from Mineral Processing Waste¹

Alumina

Ormet, Burnside, LA

Coal Gasification

Dakota Gasification, Beulah, ND

Copper

ASARCO, El Paso, TX

ASARCO, Commencement Bay, Tacoma, WA

Anaconda, MT

Valley Materials Corporation

(Midvale Slag), Midvale, UT

Ferrous Metals

LTV Steel, Aliquippa, PA

Hydrofluoric Acid

Allied-Signal, Geismar, LA

Lead

Doe Run, Boss, MO

ASARCO, Glover, MO

ASARCO, E. Helena, MT

ASARCO, El Paso, TX

Valley Materials Corporation

(Midvale Slag), Midvale, UT

Phosphoric Acid

Gardinier, East Tampa, FL

Seminole, Bartow, FL

Central Phosphates, Plant City, FL

Texasgulf, Aurora, NC

Arcadian, Geismar, LA

Agrico, Donaldsonville, LA

Nu-West, Caribou, ID

Zinc

Zinc Corporation of America

(Palmerton Zinc), Palmerton, PA

Zinc Corporation of America, DePue, IL

ASARCO, Columbus, OH

ASARCO, El Paso, TX

¹ Facilities are listed under each sector for which there is a documented case of danger.

Appendix B-4

Example of RCRA §3007 Data Request

**Office of
Solid Waste and Emergency Response**

OMB # 2050-0092
Expires: 12/89

Name
Address

Dear Sir:

The U.S. Environmental Protection Agency (EPA) is gathering data on selected mineral processing wastes. Currently, solid wastes from mineral processing operations are excluded from regulation under Subtitle C of the Resource Conservation and Recovery Act (RCRA), as amended, [see 40 CFR 261.4(b)(7)]. On July 29, 1988, the U.S. Court of Appeals for the District of Columbia Circuit directed EPA to narrow the scope of this exclusion and complete the Report to Congress required by Section 8002(p) of RCRA for the wastes that remain excluded under the narrower scope. [Environmental Defense Fund v. EPA, 852 F. 2d 1316 (D.C. Cir. 1988)]. The data that EPA is gathering are needed by the Agency to help determine which processing wastes will remain within the exclusion and be studied in the Report to Congress. In addition, the data will be used in preparation of the Report to Congress.

As part of this data gathering effort, EPA recently mailed your firm the "National Survey of Solid Wastes from Mineral Processing Facilities" (OMB # 2050-0098). The survey is designed primarily to collect information on the generation and management of selected wastes at your _____ processing facility. This letter is intended to gather additional information -- data on waste characteristics.

EPA is requesting that you submit all existing data collected since January 1, 1984 on the physical (e.g., solids content or percent moisture, particle size) and chemical composition (i.e., presence and concentration of elements and compounds included in 40 CFR Part 264, Appendix IX), radioactivity, and pH (if applicable) of any of the following wastes generated at your processing facility:

- ▼ [slag, process wastewater, air pollution control dust/sludge, etc.]

Existing data from extraction-type tests is also requested. In particular, the Agency is interested in the results of any synthetic precipitation leach tests (method 1312) and Extraction Procedure (EP) toxicity tests (method 1310) that have been performed (see "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," third edition, SW-846). However, the Agency also requests data from any other extraction-type tests that have been performed.

You are requested to submit hard copies of the appropriate data within two weeks of receiving this letter. All data submitted should clearly indicate the type of waste to which they apply, the date the sample was collected, and the analytical method(s) used.

In the event that you have few or none of the existing data being requested, or you have reason to believe that the existing data are not representative of the waste that you currently generate, you may wish to voluntarily collect new data through sampling and analysis. If you choose to collect new data, you must notify the Agency of your intention to do so within two weeks of receiving this letter. These new data must be developed using the methods found in the third edition of "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846. In addition, the data must be received by the Agency no later than 60 calendar days after receipt of this letter.

We are requesting this information under authority of Section 3007 of RCRA. Failure to respond to this information request within the specified amount of time may lead to penalties under Section 3008(a). In addition, information obtained under RCRA Section 3007 must be made available to the public unless you demonstrate to EPA that it is confidential. The treatment of confidential business information is provided for by Section 3007(b) of RCRA and regulations contained in 40 CFR Part 2.

If you have any questions in response to this inquiry, please contact Bob Hall at (202) 475-8814. We look forward to your response.

Sincerely,

David Bussard
Acting Director
Waste Management Division

Appendix B-5

List of Published Reports, Papers, Abstracts, and Data

Appendix B-5

List of Published Reports, Papers, Abstracts, and Data

This bibliography contains many of the documents (e.g., journal articles, reports, surveys, trip reports, and miscellaneous correspondence) which contributed to the Agency's understanding of the waste streams under consideration. This is not a complete inventory of the documents cited in the report, and some of the documents reported in this bibliography are not cited in the report. Documents which only contain information on a single sector are organized by sector, in the same order as the chapters of the report. Documents with information on more than one sector are located at the end of the bibliography under the heading "Multisector Documents".

Alumina

1. Shiao, S.J. and K. Akashi, "Phosphate Removal From Aqueous Solution From Activated Red Mud," Journal WPCF, Vol. 49, No. 2, February 1977, pp. 280-285.
2. Baseden, S. and D. Grey, "Environmental Study of the Disposal of Red Mud Waste," Marine Pollution Bulletin, Vol. 7, No. 1, January 1976, pp. 4-7.
3. Fuller, Robert D., Emily D.P. Nelson, and Curtis J. Richardson, "Reclamation of Red Mud (Bauxite Residues) Using Alkaline-Tolerant Grasses with Organic Amendments," Journal of Environmental Quality, Vol. 11, No. 3, 1982, pp. 533-539.
4. Couillare, D., "Use of Red Mud, A Residue of Alumina Production by the Bayer Process, in Water Treatment," The Science of the Total Environment, Vol. 25, 1982, pp. 181-191.
5. "Kaiser Develops Red Mud Disposal System," Engineering and Mining Journal, June 1975, p. 140.
6. R.L.W. (only initials given), "Alcoa of Australia Has New Alumina Operations Ready for Market Recovery," Engineering and Mining Journal, November 1983, pp. 77-81.
7. Parekh, B.K. and W.M. Goldberger, "Utilization of Bayer Process Muds: Problems and Possibilities," Proceedings of the Sixth Mineral Waste Utilization Symposium, Chicago, IL, May 2-3, 1978, pp. 122-132.
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9. Wagh, Arun S. and Willard R. Pinnock, "Occurrence of Scandium and Rare Earth Elements in Jamaican Bauxite Waste," Economic Geology, 1987, pp. 757-761.
10. Thakur, R. and B.R. Sant, "Utilization of Red Mud," Journal of Scientific Industrial Research, August 1974, pp. 408-416.
11. Knight, J.C., Arun S. Wagh, and W.A. Reid, "The Mechanical Properties of Ceramics from Bauxite Waste," (Journal Unknown), 1986, pp. 2179-2184.
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B-5-2 Appendix B-5: List of Published Reports

13. Parekh, B.K. and W.M. Goldberger, Battelle, An Assessment of Technology for Possible Utilization of Bayer Process Muds, EPA 600/2-76-301, Environmental Protection Technology Series, prepared for Industrial Environmental Research Laboratory, ORD, U.S. Environmental Protection Agency, December 1976.
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15. Blank, H.R., "Red Mud from Alumina Plants as a Possible Source of Synthetic Aggregate," Journal of Testing and Evaluation, September 1976, pp. 355-358.
16. Pincus, Alexis G., "Wastes from Processing of Aluminum Ores," Proceedings of the First Mineral Waste Utilization Symposium, Chicago, IL, March 27-28, 1968, pp. 40-49.
17. Shultz, Forrest G. and John S. Berber, "Hydrogen Sulfide Removal from Hot Producer Gas with Sintered Absorbents," Journal of Air Pollution Control Association, 1970, pp. 93-96.
18. Friedrich, Vlem, "Production of Vanadium Slag from Bauxite Red Mud," Technical Digest, 1967, pp. 443-444.
19. Thakur, R.S. and B.R. Sant, "Utilization of Red Mud: Part I -- Analysis and Utilization as Raw Material for Absorbents, Building Materials, Catalysts, Fillers, Paints and Pigments," Journal of Scientific and Industrial Research, Vol. 42, February 1983, pp. 87-108.
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Appendix C-1

Risk Assessment Screening Criteria

Appendix C-1

Risk Assessment Screening Criteria

As described in Section 2.2.2 of Volume II of this report, EPA began its risk assessment of mineral processing wastes by assessing the intrinsic hazard of each waste stream. The Agency assessed intrinsic hazard by comparing the concentrations of chemical and radioactive contaminants in each waste and waste leachate to a series of conservative screening criteria. Concentrations above the screening criteria were interpreted as an indication that the wastes conceivably could pose risk to human health or the environment under a set of very conservative, hypothetical release and exposure conditions -- exceedances of the criteria should not, in isolation, be interpreted as proof of hazard. If any sample of a waste from any facility contained a contaminant concentration in excess of a screening criterion, EPA used that as a basis for proceeding to the next step of the assessment to evaluate the site-specific factors that influence the waste's risk in more detail. Contaminants that never exceeded a screening criterion were dropped from further analysis.

Section 2.2.2 describes the rationale and process for developing the different categories of screening criteria. This appendix lists the specific numerical values that were used as criteria, as well as the regulatory or toxicological benchmarks upon which the criteria were based. In particular, the appendix provides the following four exhibits:

1. Exhibit C-1-1, Human Health Screening Criteria for Comparison to Liquid/Leachate Samples;
2. Exhibit C-1-2, Resource Damage Screening Criteria for Comparison to Liquid/Leachate Samples;
3. Exhibit C-1-3, Aquatic Ecological Screening Criteria for Comparison to Liquid/Leachate Samples; and
4. Exhibit C-1-4, Screening Criteria for Comparison to Solid Samples.

Exhibit C-1-1
Human Health Screening Criteria
for Comparison to Liquid/Leachate Samples

Constituent	Drinking Water Benchmarks			Human Health Screening Criterion (µg/L)
	Cancer Benchmark ^(a) (µg/L)	Noncancer Benchmark ^(b) (µg/L)	Associated Noncancer Effect	
Aluminum				-- ^(c)
Antimony		14	Cardiac effects	140
Arsenic	0.2	35	Dermal effects	2
Barium		1,800	High blood pressure	18,000
Beryllium		180	Decreased growth	1,800
Boron		3,200	Adv. effect to repro. organs	32,000
Cadmium		18	Renal effects	180
Chloride				--
Chromium (VI)		180	Kidney, liver damage ^(d)	1,800
Cobalt				--
Copper		1,300	GI irritation	13,000
Fluoride		2,100	Dental fluorosis	21,000
Gross alpha				
Gross beta				--
Iron				
Lead		21	Neurotoxicity	210
Magnesium				
Manganese		7,000	CNS effects	70,000
Mercury		10	CNS effects	100
Molybdenum				--
Nickel		700	Decreased weight	7,000
Nitrite		3,500	Methemoglobinemia	35,000
Nitrate		35,000	Methemoglobinemia	350,000
pH				--
Phosphate (Total)				
Phosphorus				--
Radium-226	1.6 pCi/L			16 pCi/L
Selenium		110	Dermal, neuro. effects	1,100
Silver		110	Skin discoloration	1,100
Sulfate				--
Suspended solids				
Thallium		2.5	CNS effects ^(d)	25
Thorium-232	9.1 pCi/L			91 pCi/L
Uranium-238	1.5 pCi/L			15 pCi/L
Vanadium		250	Liver, bone marrow damage ^(d)	2,500
Zinc		7,000	Hematological effects	70,000

- (a) Concentrations represent a lifetime cancer risk of 1×10^{-5} . The arsenic concentration was derived from the cancer slope factor presented in the Integrated Risk Information System (IRIS). The radionuclide concentrations were estimated based on cancer slope factors developed by EPA's Office of Radiation Programs for inclusion in the Health Effects Assessment Summary Tables (HEAST).

- (b) Derived from chronic reference doses (RfDs) presented in IRIS, with the exception of lead. For lead, an RfD of 0.0006 mg/kg-day was independently derived based on available toxicological data.
- (c) No screening criterion used because of lack of toxicological benchmarks.
- (d) Acute effects (no chronic effects at these concentrations).

Exhibit C-1-2
Resource Damage Screening Criteria for Comparison
to Liquid/Leachate Samples

Constituent	Benchmark (µg/L)	Basis for Benchmark	Resource Damage Screening Criterion (µg/L)
Aluminum	5,000	Continuous irrigation guide ^(a)	50,000
Antimony	45,000	AWQC for fish ingestion ^(b)	4,500,000
Arsenic	50	Primary MCL ^(c)	500
Barium	1,000	Primary MCL	10,000
Beryllium	1.2	AWQC for fish ingestion	120
Boron	750	Continuous irrigation guide	7,500
Cadmium	10	Primary MCL	100
Chloride	250,000	Secondary MCL	2,500,000
Chromium(VI)	50	Primary MCL	500
Cobalt	50	Continuous irrigation guide	500
Copper	1,300	Secondary MCL (proposed)	13,000
Fluoride	4,000	Primary MCL	40,000
Gross alpha	15 pCi/L	Primary MCL ^(d)	150 pCi/L
Gross beta	50 pCi/L	Primary MCL ^(d)	500 pCi/L
Iron	300	Secondary MCL	3,000
Lead	5	Primary MCL (proposed)	50
Magnesium			— ^(e)
Manganese	50	Secondary MCL	500
Mercury	2	Primary MCL (proposed)	20
Molybdenum	10	Continuous irrigation guide	100
Nickel	200	Continuous irrigation guide	2,000
Nitrite	1,000	Primary MCL	10,000
Nitrate	10,000	Primary MCL	100,000
pH	6.5-8.5	Secondary MCL	6.5-8.5
Phosphate(Total)			
Phosphorus			--
Radium-226	5 pCi/L	Primary MCL ^(d)	50 pCi/L
Selenium	10	Primary MCL	100
Silver	50	Primary MCL	500
Sulfate	250,000	Secondary MCL	2,500,000
Suspended solids			
Thallium	46	AWQC for fish ingestion	4,600
Thorium-232			
Uranium-238			--
Vanadium	100	Continuous irrigation guide	1,000
Zinc	5,000	Secondary MCL	50,000

- (a) Maximum concentrations recommended by the National Academy of Sciences in "Water Quality Criteria -- 1972." These concentrations are generally set at levels less than the concentrations that are toxic to sensitive plants when grown in sandy soils.
- (b) Ambient Water Quality Criteria (AWQC), as taken from EPA chemical-specific source documents, designed to protect against adverse human health effects caused by the ingestion of fish. For beryllium, the benchmark presented here is designed to limit cancer risks to a level of 1×10^{-5} .
- (c) Drinking water maximum contaminant level (MCL).

- (d) The MCL for gross alpha radiation excludes radon and uranium. No MCL for gross beta radiation has been issued; however, compliance with 40 CFR 141.16 may be assumed if gross beta concentrations are less than 50 pCi/L. The MCL for radium is 5 pCi/L for combined radium-226 and radium-228.
- (e) No screening criterion used because of lack of relevant benchmarks.

Exhibit C-1-3
Aquatic Ecological Screening Criteria
for Comparison to Liquid/Leachate Samples

Constituent	Benchmark (µg/L)	Basis for Benchmark	Aquatic Ecological Screening Criterion (µg/L)
Aluminum	87	Freshwater chronic AWQC ^(a)	8,700
Antimony	1,600	Freshwater chronic AWQC	160,000
Arsenic	13	Saltwater chronic AWQC ^(b)	1,300
Barium	50,000	Freshwater chronic guide ^(c)	5,000,000
Beryllium	5.3	Freshwater chronic AWQC	530
Boron	5,000	Saltwater chronic guide	500,000
Cadmium	1.1	Freshwater chronic AWQC	110
Chloride	230,000	Freshwater chronic AWQC	23,000,000
Chromium(VI)	11	Freshwater chronic AWQC	1,100
Cobalt			-- ^(d)
Copper	2.9	Saltwater chronic AWQC	290
Fluoride			--
Gross alpha			
Gross beta			--
Iron	1,000	Freshwater chronic AWQC	100,000
Lead	3.2	Freshwater chronic AWQC	320
Magnesium ^(e)			
Manganese	1,000	Freshwater chronic guide	100,000
Mercury	0.012	Freshwater chronic AWQC	1.2
Molybdenum			--
Nickel	8.3	Saltwater chronic AWQC	830
Nitrite	60	Freshwater chronic guide	6,000
Nitrate	90,000	Freshwater chronic guide	9,000,000
pH	6.5-9	Freshwater chronic AWQC	6.5-9
Phosphate(Total)	25-100	Freshwater chronic guide ^(f)	2,500-10,000
Phosphorus	0.1	Saltwater chronic AWQC	10
Radium-226			--
Selenium	5	Freshwater chronic AWQC	500
Silver	0.12	Freshwater chronic AWQC	12
Sulfate ^(e)			
Suspended solids	25,000	Freshwater chronic guide	2,500,000
Thallium	40	Freshwater chronic AWQC	4,000
Thorium-232			--
Total Dissolved Solids ^(e)	5,000,000	Freshwater chronic guide	500,000,000
Uranium-238			--
Vanadium	1,280	Freshwater acute guide	128,000
Zinc	86	Saltwater chronic AWQC	8,600

- (a) Ambient Water Quality Criteria (AWQC), as taken from EPA chemical-specific source documents, designed to protect freshwater organisms against harmful chronic exposures.
- (b) AWQC, as taken from EPA chemical-specific source documents, designed to protect saltwater organisms against harmful chronic exposures.
- (c) Not official AWQC, but independently developed based on the toxicological literature.
- (d) No screening criterion used because of lack of toxicological benchmarks and data.

- (e) Total dissolved solids figure for magnesium plus sulfate.
- (f) Benchmarks for phosphate are 25 µg/L within a lake or reservoir, 50 µg/L in any stream at the point where it enters a lake or reservoir, and 100 µg/L in streams or other flowing waters not discharging directly to lakes or impoundments.

Exhibit C-1-4 (cont'd)
Screening Criteria for Comparison to Solid Samples

Constituents	Soil Ingestion Screening Criteria			Particulate Inhalation Screening Criteria ^(d)		
	Cancer Benchmark ^(a) (µg/g)	Noncancer Benchmark ^(b) (µg/g)	Associated Noncancer Effect	Cancer Benchmark ^(a) (µg/g)	Noncancer Benchmark ^(b) (µg/g)	Associated Noncancer Effect
Aluminum						
Antimony		280	Cardiac effects			
Arsenic	4	700	Dermal effects	14		
Barium		35,000	Increased blood pressure		7,000	Fetotoxicity
Beryllium		3,500	Decreased growth	84		
Boron		63,000	Adverse effect to reproductive organs			
Cadmium		350	Renal effects	115		
Chloride						
Chromium(VI)		3,500	Kidney, liver damage ^(c)	17		
Cobalt						
Copper		25,900	GI irritation			
Fluoride		42,000	Dental fluorosis			
Gross alpha						
Gross beta						
Iron						
Lead		420	Neurotoxicity			
Magnesium						
Manganese		140,000	CNS effects		21,000	CNS effects
Mercury		210	CNS effects			
Molybdenum						
Nickel		14,000	Decreased weight	833		
Nitrite		70,000	Methemoglobinemia			
Nitrate		700,000	Methemoglobinemia			
pH						
Phosphate (Total)						
Phosphorus						
Radium-226				134 pCi/g ^(e)		
Selenium		2,100	Dermal, neurological effects		80	Dermatitis, GI disturbance
Silver		2,100	Skin discoloration			

Exhibit C-1-4 (cont'd)
Screening Criteria for Comparison to Solid Samples

Constituents	Soil Ingestion Screening Criteria			Particulate Inhalation Screening Criteria ^(d)		
	Cancer Benchmark ^(a) (µg/g)	Noncancer Benchmark ^(b) (µg/g)	Associated Noncancer Effect	Cancer Benchmark ^(a) (µg/g)	Noncancer Benchmark ^(b) (µg/g)	Associated Noncancer Effect
Sulfate						
Suspended Solids						
Thallium		49	CNS effects ^(c)			
Thorium-232				13 pCi/g ^(e)		
Uranium-238				17 pCi/g ^(e)		
Vanadium		4,900	Liver, bone marrow damage ^(c)			
Zinc		140,000	Hematological effects			

^(a) Concentrations presented represent a lifetime cancer risk of 1×10^{-5} . These concentrations were derived from cancer slope factors presented in the Integrated Risk Information System (IRIS), with the exception of the radionuclides and nickel. The radionuclide concentrations were estimated based on cancer slope factors developed by the Office of Radiation Programs for inclusion in the Health Effects Assessment Summary Tables (HEAST). The nickel concentration for the particulate inhalation pathway was estimated based on a cancer slope factor in the HEAST.

^(b) Derived from chronic reference doses (RfDs) presented in IRIS, with the exception of lead, barium, and manganese. For lead, an RfD of 0.0006 mg/kg-day was independently derived based on available toxicological data. For barium and manganese (particulate inhalation pathway only), RfDs were taken from the HEAST.

^(c) Acute effects (no chronic effects at these concentrations).

^(d) Concentrations for particulate inhalation pathway were estimated based on the assumption that the airborne particulate concentration is $50 \mu\text{g}/\text{m}^3$. This particulate concentration is the National Ambient Air Quality Standard (annual arithmetic mean) for particulate matter.

^(e) These radionuclide concentrations relate only to the risk caused by the inhalation of each of the radionuclides by themselves. They do not account for other exposure pathways (e.g., direct radiation) or for the inhalation of radioactive decay products.

Exhibit C-1-4 (cont'd)
Screening Criteria for Comparison to Solid Samples

Constituents	Radiation Exposure Screening Criteria		Air Resource Damage Screening Criterion	
	Benchmark (pCi/g)	Basis	Benchmark (µg/g)	Basis
Radium-226	5	EPA cleanup standard for uranium mill tailings ^(f)		
Thorium-232	10	NRC cleanup guide ^(g)		
Uranium-238	10	NRC cleanup guide ^(g)		
Lead			30,000	Could result in exceedance of NAAQS ^(h)

^(f) This standard, provided in 40 CFR 192, applies to the top 15 centimeters of soil. It is designed to limit the risk from inhalation of radon decay products in houses built on contaminated land, and to limit gamma radiation exposures of people using contaminated land.

^(g) Nuclear Regulatory Commission (NRC) recommended cleanup limit presented in "Disposal or Onsite Storage of Residual Thorium or Uranium (Either as Natural Ores or Without Daughters Present) from Past Operations." These limits, which are based on the assumption that U-238 and Th-232 are in secular equilibrium with their respective decay products, are based on EPA's standard in 40 CFR 192; the concentrations are believed to be acceptably low, making it unnecessary for the NRC to restrict the method of burial.

^(h) Calculated based on the assumption that the airborne particulate concentration is 50 µg/m³, the National Ambient Air Quality Standard (annual arithmetic mean) for particulate matter.

Appendix C-2

Summary of MMSOILS Model

Appendix C-2

Summary of MMSOILS Model

Introduction

MMSOILS is a multimedia exposure and risk estimation model that was originally developed by EPA's Office of Research and Development (ORD). The model is a screening tool designed to assist EPA in setting priorities for hazardous waste management.

MMSOILS was designed to estimate exposures and health risks associated with the release and subsequent fate and transport of chemicals from contaminated soils. The four basic functions of the multimedia methodology are to:

- (1) Estimate chemical release rates from the soil into various environmental media (air, ground water, surface water, food sources), based on chemical properties and land use at the site;
- (2) Estimate the chemical concentration at exposure points in each environmental media considered, based on the chemical release rate and the proximity to exposed populations;
- (3) Estimate human exposures through inhalation, ingestion, and absorption based on the chemical concentration at exposure points and assumptions regarding human intake levels; and
- (4) Estimate the potential health risk based on toxicity data for the specific chemical, based on toxicity data for the chemical and the estimated human exposures at exposure points.

MMSOILS has been used for comparison with an EPA dioxin exposure assessment document (EPA 1988), with favorable results. It also has undergone extensive peer review by several offices of EPA and members of the academic community. The model documentation (ICF Technology, Inc. 1989) provides more detailed description of MMSOILS.

Adaptations for the Mineral Processing Waste Risk Assessment

The mineral processing waste risk assessment required modeling of multiple chemicals released from a variety of waste containment units, not just contaminated soil. MMSOILS was identified as an appropriate model for the task, but three major model modifications were required.

First, algorithms for predicting contaminant releases from waste management units such as waste piles, landfills, surface impoundments, and injection wells, were added. As part of this change, the water balance component, which accounts for precipitation, evapotranspiration, and recharge, was revised to accommodate changes in the waste management units with time, such as the installation of a cap on a landfill, or the gradual failure of a liner. MMSOILS now allows the user to specify a cover and liner design, and the magnitude and timing of waste containment failure. Cover designs include vegetative, clay, and RCRA cap. Liner designs include unlined, clay, single synthetic, composite (clay, membrane, and collection system), and a double liner that meets minimum technology requirements of HSWA Section 3004(o). The user can specify up to five independent failure events throughout the simulation period.

Second, a selection of leachate quality algorithms was added. While the liner/cover design and failure/release components of the model estimate the quantity of leachate released each year from a waste management unit, the leachate quality algorithms estimate the contaminant concentrations in the waste leachate. These algorithms are dependent upon the waste management unit chosen. There are three mathematical approaches available for waste piles, landfills, and surface impoundments. As a matter of practice in the mineral processing waste risk assessment, however, leachate quality was modeled as steady-state contaminant concentrations that equal the median concentrations measured in extraction procedure leach tests (as discussed in Chapter 2 of this report).

Third, MMSOILS was expanded to process multiple chemicals. Concentrations and resulting risks of individual contaminants can be calculated for each desired pathway, and an overall risk can be summed across constituents.

Overview of Major Release and Transport Modules

MMSOILS is divided into five distinct transport pathways: atmospheric, surface water, ground water, soil erosion, and food chain bio-accumulation.

The Atmospheric Pathway

The atmospheric pathway is simulated if the potential for airborne releases exists at the site. The atmospheric pathway component of the model considers the release of contaminants from the site in the form of vapors and fugitive dust emissions from wind erosion and mechanical disturbances (however, with the exception of the coal gasification wastes, only dust releases were relevant for the mineral processing waste risk assessment). Once the contaminant is in the atmosphere, it is transported by wind and dispersed due to turbulence in the flow. MMSOILS represents the following processes: volatilization from soils, volatilization from a water body, particulate emissions due to wind erosion and mechanical disturbances, atmospheric transport and dispersion, and atmospheric deposition.

The equation used in MMSOILS for estimating the release of windblown dust assumes that there is an "unlimited reservoir" of erodible particles. This equation (adapted from EPA 1985) is an empirical relationship of field and climatic factors that was developed based on field measurements of dust releases from sandy agricultural soils. Therefore, application of this release equation to many of the mineral processing wastes studied in this report is very conservative (i.e., it tends to overpredict releases). Many of the mineral processing wastes actually contain a "limited reservoir" of erodible material, consisting of a mixture of erodible and non-erodible elements such as large particles or fragments on the surface. These non-erodible elements consume part of the shear stress of the wind that otherwise would be transferred to erodible particles.

The Surface Water Pathway

The surface water pathway needs to be simulated if there is a potential for contaminants to leave the site via run-off into surface water or discharge of affected ground water. The surface water pathway component of the model evaluates contaminants entering one of two types of receiving water bodies, a stream/river or a small lake. For contaminants entering a small lake, the source term is the contaminated bed sediments resulting from the erosion of contaminated particles (either waste material or soil) from an adjacent waste site. The potential source terms incorporated in the model for contaminants entering a stream include the erosion of contaminants adsorbed to the solid particles and the discharge of contaminated groundwater into the stream. The potential source term of contaminant dissolved in surface run-off from the site entering a stream or a lake is not addressed in the model. Once contaminants have reached the water body, a concentration in the water is estimated by assuming that the contaminants are completely mixed in the water's flow.

In the mineral processing waste risk assessment, EPA's surface water modeling considered only the chronic (i.e., steady-state) loading of contaminants to surface waters. Monthly average precipitation rates and annual average surface water flow rates were used as model inputs. The Agency did not model larger short-term releases, such as those associated with large storms, that could result in higher contaminant concentrations that last for shorter durations.

The Ground-Water Pathway

The ground-water pathway is simulated if there is a potential for contaminants to be transported through the unsaturated and saturated ground-water systems. The ground-water pathway component of the model examines the net recharge, leaching of contaminants from the soil, transport through the partially saturated zone, and contaminant transport/dispersion within an aquifer. Recharge is calculated using a yearly water balance, which adds system inputs (such as precipitation and irrigation) and subtracts outputs (such as run-off and evapo-transpiration). Landfills, waste

piles, and surface impoundments each have three options available for calculating contaminant leaching. Flow through the partially saturated zone is assumed to be steady state, and one dimensional. The fate and transport of a contaminant in an aquifer is estimated based on a quasi-analytical solution to the advection dispersion equation incorporating retardation and first order decay.

The Soil Erosion Pathway

The soil erosion pathway is analyzed if there is a potential for contaminated soil to be eroded off-site to potential exposure points. The soil erosion pathway component of the model is used to evaluate contaminant movement to off-site soils through two mechanisms: soil erosion and atmospheric deposition. Although atmospheric deposition is not related to soil erosion processes, the effect of atmospheric deposition is included at this point in the model since it is a mechanism by which off-site soils may become contaminated. MMSOILS represents soil erosion from a site, delivery fraction of eroded soil and mixing with off-site soils, and soil contamination due to atmospheric deposition.

The Food Chain Pathway

The food chain bio-accumulation pathway needs to be simulated if there exists a potential for contaminants to enter the food chain. The food chain bioaccumulation pathway component of the model uses the transport of contaminants from the site via other environmental transport pathways as the source term(s). Examples of environmental transport pathways that may serve as the source terms for the food chain pathway include atmospheric transport and deposition, soil erosion, and migration within ground-water and subsequent use for irrigation. Based on these source terms, the food chain pathway component examines the accumulation of a chemical within fish, terrestrial plants, and cattle. Simple representations of bioaccumulation using bioconcentration factors and transfer factors are used in MMSOILS. The bioconcentration factors are used to represent the partitioning of a chemical between: (1) water and fish, (2) edible parts of terrestrial plants and soil, and (3) root vegetables and soil moisture. The transfer factors are used to represent the uptake of chemical by animals as a function of the mass of chemical ingested in feed and water.

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Appendix D-1

Existing Federal Regulatory Controls Addressing Mineral Processing Wastes

Appendix D-1

Existing Federal Regulatory Controls

Addressing Mineral Processing Wastes

1. Applicable Federal Regulations

While temporarily excluding all "[s]olid waste from the extraction, beneficiation, and processing of ores and minerals" from regulation as hazardous waste under RCRA Subtitle C provisions, the 1980 Bevill amendment did not preclude their regulation under "other provisions of federal or state law...." This includes their current regulation under Subtitle D of RCRA and a variety of other federal and state air quality, water quality, and solid and hazardous waste management requirements. Pending development of a RCRA Subtitle D program that addresses mining wastes, EPA has stated its intention to use Section 7003 of RCRA and Sections 104 and 106 of CERCLA "to protect against substantial threats and imminent hazards" (51 FR 24496). These provisions are mentioned under the discussions of RCRA and CERCLA, below.

Legal requirements vary, depending on the waste(s) or waste constituent involved, and the ownership -- public or private -- of the land involved. This appendix provides an overview of potentially applicable federal laws, and the provisions that relate to the disposition of ore processing wastes.

2. Summary of Federal Laws and Regulations

There are several federal statutes that directly and indirectly affect the disposition of mineral processing wastes. The key laws and responsible agencies are listed in Exhibit D-1-1. The important provisions of these federal laws and their associated regulations as they relate to the management and disposal of special wastes from mineral processing are summarized below.

3. Hazardous Waste

RCRA Subtitle C

In 1976, Congress enacted the Resource Conservation and Recovery Act (RCRA), which established comprehensive requirements for the management of solid and hazardous wastes. Specific requirements for hazardous wastes are found in Subtitle C of RCRA. Subtitle C provides a statutory framework for tracking all hazardous and toxic wastes from "cradle to grave," that is, from their generation to their final disposal, destruction, or recycling.

Pursuant to regulations issued by EPA (40 CFR Part 261), solid wastes which meet EPA hazardous waste criteria with respect to "toxicity, persistence, degradability in nature, potential for accumulation in tissue, and other related factors such as flammability, corrosiveness..." [Section 3001(a)] are subject to the statute's labeling, storage, transportation, and disposal requirements.

Generally, some mineral processing solid wastes would otherwise qualify as hazardous wastes under RCRA. However, pursuant to the statute's provisions under Section 3001(b)(3)(A)(ii), "[s]olid waste from the extraction, beneficiation, and processing of ores and minerals, including phosphate rock and overburden from the mining of uranium ore" are conditionally exempt from regulation under Subtitle C. EPA may respond to a waste management situation that presents "an imminent and substantial endangerment to health or the environment" under the authority of Section 7003 of RCRA. Actions sanctioned by Section 7003 include filing suit on behalf of the United States to order the violator to stop the activity, as well as the

Exhibit D-1-1
**Federal Laws Applicable to Mineral Extraction,
Beneficiation, and Processing Wastes**

Number	Statute	Regulations	Lead Agency
642 USC 6901-6991i	The Resource Conservation and Recovery Act of 1976 (RCRA), as amended by the Hazardous and Solid Waste Act of 1984 (HSWA)	40 CFR 255-280	EPA
42 USC 9601-9675	The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA)	40 CFR 300-306	EPA
33 USC 1251-1376	The Federal Water Pollution Control Act (FWPCA), as amended by the Clean Water Act (CWA) of 1977 and the Water Quality Act of 1987 (WQA)	40 CFR 122, 123, 125, 130, 131, 230, 231, 403, 415, 418, 420, 421, 422, 436	EPA
42 USC 300f-300j-11	The Safe Drinking Water Act of 1984 (SDWA), as amended by the SDWA amendments of 1986	40 CFR 141-149	EPA
42 USC 7401-7641	The Clean Air Act of 1970 (CAA), as amended by the CAA amendments of 1977	40 CFR 50, 57, 60, 61	EPA
42 USC 4341	The National Environmental Policy Act of 1969 (NEPA)	40 CFR 6, 1500-1508	EPA
43 USC 1701	The Federal Land Policy and Management Act of 1976 (FLPMA)	43 CFR 3801-3870 (BLM)	DOI

* EPA: Environmental Protection Agency
DOI: Department of the Interior
BLM: Bureau of Land Management

commencement of necessary actions for cleanup or the issuance of administrative orders as may be necessary to protect public health and the environment.

Of the states analyzed in this report, only three do not have EPA approved programs for regulating Subtitle C wastes. California, Idaho, and Ohio do not have primacy for Subtitle C, and therefore, mineral processing operations in these states are subject to the above federal regulations.

Superfund

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or Superfund, was enacted to provide the federal government with the authority and resources to respond to situations in which pollutants or contaminants are or may be released into the environment such that they pose an "imminent and substantial danger to the public health or welfare..." (Section 104). Uncontrolled run-off, leachates, and other air and water emissions, or releases from ore processing facilities that are not authorized by permits under other federal and/or state laws can be subject to the regulatory and liability provisions of the statute.

CERCLA authorizes EPA to respond to immediate threats to the environment or human health in situations where a responsible party cannot act or cannot be readily identified. EPA has stated its intent to use CERCLA response and abatement authorities, Sections 104 and 106, to respond to imminent hazard situations at mineral production sites

if required (51 FR 24496). In such situations, EPA can proceed with necessary containment or removal actions. Where conditions allow, the Agency can also undertake more detailed remedial investigation and feasibility studies of abandoned or inactive waste sites necessary for the design and execution of long term remedial actions. Section 106 provides authority for orders necessary to protect public health and welfare and the environment and provides enforcement authority as well.

In those situations where responsible parties that can respond "properly and promptly" can be identified, EPA is authorized to establish what remedial actions are required and to oversee the responsible parties' cleanup efforts. In all cases, the owners and/or other responsible parties are liable for the costs of cleaning up the hazardous waste problem, and for correcting damages to affected natural resources (Section 107).

Under the law, EPA is required to establish and periodically update a National Contingency Plan (NCP, Section 105) which includes, among other things:

[C]riteria for determining priorities among releases or threatened releases throughout the United States for the purposes of taking remedial action and, to the extent practicable taking into account the potential urgency of such action, for the purpose of taking removal action. Criteria and priorities...shall be based upon relative risk or danger to public health or welfare or the environment...taking into account to the extent possible the population at risk, the hazard potential of the hazardous substances at such facilities, the potential for contamination of drinking water supplies, the potential for direct human contact, the potential for destruction of sensitive ecosystems, the damage to natural resources which may affect the human food chain...the contamination or potential contamination of the ambient air...[Section 105 (a)(8)(A)].

These criteria have been incorporated into a hazard ranking system (HRS) which is used to evaluate uncontrolled hazardous waste sites around the country, and to rank them according to degree of overall hazard. Sites that receive HRS scores greater than 28.5 are listed on the National Priorities List (NPL) which makes them eligible for federal funding of additional remedial response activities.

Pursuant to the amendments to CERCLA -- the Superfund Amendments and Reauthorization Act of 1986 (SARA) -- EPA must further revise the NCP to "assure, to the maximum extent feasible, that the hazard ranking system accurately assesses the relative degree of risk to human health and the environment posed by sites and facilities subject to review" [Section 105(c)]. SARA also requires that, pending revision of the HRS, the addition of any uncontrolled hazardous waste sites containing "significant quantities" of mining wastes -- i.e., special study wastes under RCRA Section 3001(b)(3)(A) (including wastes from materials generated from the extraction, beneficiation, and processing of ores and minerals), or other special study wastes -- to the NPL must take into account the following factors:

- (1) The extent to which the hazard ranking system score for the facility is affected by the presence of any special study waste at, or any release from, such facility.
- (2) Available information as to the quantity, toxicity, and concentration of hazardous substances that are constituents of any special study waste at, or released from such facility, the extent of or potential for release of such hazardous constituents, the exposure or potential exposure to human population and the environment, and the degree of hazard to human health or the environment posed by the release of such hazardous constituents at such facility. This subparagraph refers only to available or actual concentrations of hazardous substances and not to the total quantity of special study waste at such facility [Section 105(g)(2)].

A proposed rule modifying the Hazard Ranking System was published in the *Federal Register* in December, 1988, and is being finalized at this time.

The SARA legislation also requires that for facilities at which hazardous wastes are left on-site, the remedial cleanup plan must ensure that all "legally applicable" federal and state standards that may exist for the hazardous substances in question are achieved [Section 121(d)(2)(A)].

4. Solid Waste

RCRA Subtitle D

Non-hazardous solid waste is regulated under Subtitle D of RCRA. Ore and mineral extraction, beneficiation, and processing operations generally involve the generation, transport, storage, treatment, and disposal of a wide variety of solid wastes including; overburden, waste rock, tailings, lubricants, solvents, chemical reagents, refuse, and sewage.

Wastes generated from the extraction, beneficiation, and processing of ores and minerals (i.e. hard-rock, non-fuel mining operations) were temporarily excluded, pending further study, from regulation under the RCRA Subtitle C hazardous waste program by Section 3001 of RCRA (i.e., the Bevill exclusion) in 1980. Following the release of a Report to Congress in 1985, EPA made a regulatory determination in 1986 (51 FR 24496) that all of the wastes addressed by the 1985 Report to Congress would be regulated under Subtitle D of RCRA rather than Subtitle C because of the relatively large volume, low hazard nature of those wastes. EPA determined further that it would develop a new program under Subtitle D that would be flexible, site-specific, risk-based, and tailored otherwise to address these mining wastes specifically, rather than relying on existing Subtitle D programs. EPA is in the early stages of developing such a regulatory program and has included one possible form of a risk-based, tailored, regulatory program for mineral industry wastes in this report for analytical purposes (see Appendix E-2).

While there is not yet a federal program in place to address mineral industry wastes under Subtitle D, many states have developed Subtitle D programs for future EPA approval. While desirable, the adoption of a state solid waste program which meets minimum requirements specified by the Act is not mandatory. If a state refuses to adopt and enforce its own solid waste management program, EPA currently has no statutory authority to adopt or enforce a federal program in lieu of the state's; it can only withhold funds and technical expertise from the state. Eight states do not as yet have EPA approved Subtitle D plans, including: Idaho, Missouri, Montana, New Mexico, Utah, Maryland, Nevada, and West Virginia. Seven of these states contain one or more facilities that generate special wastes addressed by this report.

The definition of solid waste in the federal solid waste regulations is intended to include wastes generated by the mineral processing industry. According to the federal statute, all wastes must be disposed in compliance with EPA's criteria listed in 40 CFR Part 257.

Waste disposal facilities that meet the criteria in 40 CFR 257.2 are defined as sanitary landfills. Facilities that do not comply with the regulations are defined as open dumps. Open dumping is prohibited under Section 4005 of RCRA. A disposal site such as a tailings pond or waste pile at a mining or processing facility is treated as a "sanitary landfill" or an "open dump." If a site is found to meet EPA's criteria, it could be considered a sanitary landfill and allowed to continue operating. If a disposal site does not meet EPA's criteria, the site could be treated as an "open dump" and must be closed or upgraded in accordance with a compliance schedule outlined by the state.

5. Water Quality

The Clean Water Act

The primary statute for controlling water pollution from mineral processing facilities is the Federal Water Pollution Control Act of 1972, amended in 1977 as the Clean Water Act (CWA). The law establishes the national goals of eliminating the discharge of pollutants into navigable waters and, "water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water."

Under the Clean Water Act, "the discharge of any pollutant by any person" from a point source into the surface waters of the nation, except as authorized by a permit, is illegal [Section 301(a)]. Accordingly, any entity seeking to discharge a wastewater effluent to a surface water body must apply for a permit. Permits, which can have terms of up to 5 years, are issued by EPA under the National Pollutant Discharge Elimination System (NPDES) permit program. Title IV of the law establishes permit requirements. Generally, a permit will set forth the specific "effluent limitations" that pertain to specific types of discharges. Permits also usually contain compliance dates and any germane monitoring and reporting requirements.

EPA has approved state programs for implementing the NPDES requirements for all of the states analyzed in this report except for: Arizona, Idaho, New Mexico, Texas, and Louisiana.

Under the law, EPA also has the responsibility for setting "effluent limitations," based on the performance capability of treatment technologies. These "technology based limitations" -- expressed in terms of a pollutant concentration, and not the technology itself -- must be established for various classes of industrial discharges, which include a number of mineral processing categories. These limitations are the basis for minimum requirements of NPDES permits. Permits for mineral processing facilities may require compliance with effluent guidelines based on best practicable control technology currently available (BPT) or best available technology economically achievable (BAT). Pursuant to Section 301(b) of the Act, dischargers were required to achieve effluent limitations based on BPT or any more stringent limitation, including those necessary to meet water quality standards, treatment standards, or schedules of compliance, established by state or federal law, by July 1, 1977. Facilities must have achieved effluent limitations based on BAT no later than 3 years after they were established or no later than March 31, 1989.

Exhibit D-1-2 provides relevant citations for applicable effluent guidelines for the twelve commodity sectors discussed in this report.

The CWA also allows EPA to delegate Title IV authority for issuing NPDES permits to qualified states. In such instances, only one state permit need be issued. In states where delegation has not occurred, a federal permit must be obtained. In cases where the state does not have an approved NPDES program, such as Texas, Louisiana, and Idaho, EPA applies the guidelines discussed above. EPA will also adopt any limits necessary to achieve applicable state water quality standards.

The CWA also requires that states establish water quality standards for all surface waters. The standards are subject to EPA approval, and must meet minimum federal criteria. However, states are allowed to set more stringent requirements than those established by EPA. The law allows both EPA and the states to impose "any more stringent [effluent] limitation, including those necessary to meet water quality standards" [Section 301(b)(1)(C)]. The stringency of a particular set of water quality standards, established for stretches or "reaches" of a water course, can significantly affect what will be required to comply with a discharge permit.

Exhibit D-1-2 Federal Regulations Establishing Applicable Effluent Guidelines

Commodity Sector	Regulation	
	Existing Sources	New Sources
Alumina	40 CFR 421	40 CFR 421
Sodium Dichromate	40 CFR 415	40 CFR 415
Coal Gasification	None	None
Primary Copper	40 CFR 421	40 CFR 421
Elemental Phosphorus	None	None
Ferrous Metals	40 CFR 420	40 CFR 420
Hydrofluoric Acid	40 CFR 415	40 CFR 415
Primary Lead	40 CFR 421	40 CFR 421
Magnesium	40 CFR 436	None
Phosphoric Acid	40 CFR 418, 422	40 CFR 418, 422
Titanium Tetrachloride	40 CFR 415	40 CFR 415
Primary Zinc	40 CFR 421	40 CFR 421

If primary processing facilities discharge to publicly-owned treatment works (POTWs), they are subject to pretreatment standards for new and existing sources. Pretreatment standards for new sources from bauxite (alumina), copper, lead, and zinc primary processing facilities are presented in 40 CFR Part 421. Pretreatment standards for existing sources for lead and zinc are also included in 40 CFR Part 421; standards for existing sources for bauxite (alumina) and copper have not been promulgated.

Nonpoint sources of pollution are addressed under the law's Section 208 areawide waste treatment management planning program requirements, which require states to prepare detailed plans for waste management and identification and mitigation of adverse environmental impacts of waste management practices. Nonpoint sources are also specifically addressed by Section 319 of the Clean Water Act Amendments of 1987. Section 319 required states to submit to EPA a program for controlling nonpoint pollution within 18 months of enactment of the amendments. The Act states that in each fiscal year, priority may be given for receipt of federal grant monies to states which have included ground-water protection activities as part of their nonpoint pollution control programs.

Other provisions of the CWA which may affect mineral processing sites are requirements for the disposition of dredged fill materials and waste sludges under Section 404 and controls on the release of oil or hazardous substances under Section 311.

The Safe Drinking Water Act

The Safe Drinking Water Act (SDWA), has several provisions that are significant to mineral processing facilities, including the law's requirements for setting drinking water regulations and Maximum Contaminant Levels (MCLs) for toxic water contaminants, and for regulating underground injection of wastes and protecting sole source aquifers. MCLs are "the maximum permissible level of a contaminant in water which is delivered to any user of a public water system" (Section 1401). EPA is responsible for establishing MCLs for pollutants in drinking water. MCLs for many

of the inorganic compounds found at mining waste sites are set forth in 40 CFR 141.11(b). The MCLs for the waste streams analyzed in this report are:

Contaminant	Level in mg/L
Chromium	0.05
Lead	0.05

The MCLs constitute one of the primary classes of applicable and relevant or appropriate requirements (ARARs) that can be used to determine the level of cleanup required at Superfund sites containing mining wastes (see CERCLA Section 122(d)(2)(A)). The SDWA also requires the Agency to establish secondary MCLs; that is, standards that reflect welfare factors such as odor, taste, and color. While these may have little or no direct effect on human health, their violation can be used to justify the abandonment of a water source, or treatment to remedy the problem. For the wastes analyzed in this report, the secondary drinking water standards are:

Contaminant	Level in mg/L
Copper	1
Zinc	5
Iron	0.3
Sulfate	250

Ground water is protected under Part C of the SDWA, "Protection of Underground Sources of Drinking Water," which sets forth requirements for regulating waste disposal through the use of underground injection techniques. Generally, the provision sets criteria for protecting the quality of aquifers used for drinking water from potential contamination from such techniques. EPA regulations pertaining to these provisions of the law can be found at 40 CFR Parts 144-147.

These statutory provisions focus on the use of Underground Injection Control (UIC) techniques, which entail injection of fluids for waste disposal or resource recovery. Well injection is the subsurface emplacement of fluids into any bored, drilled, or driven shaft or dug hole, whose depth is greater than the largest surface dimension (40 CFR 146.03). Five classes of underground injection wells are designated in 40 CFR 144.6:

- ▼ Class I - used to inject hazardous waste beneath the lowermost formation containing, within one-quarter mile of the well bore, an underground source of drinking water (USDW);
- ▼ Class II - used to inject fluids which are brought to the surface in connection with oil or natural gas recovery or storage operations;
- ▼ Class III - used to inject fluids for extraction of minerals, including mining of sulfur by the Frasch process, in situ production of uranium or other metals, or solution mining of salts or potash (includes only solution mining from ore bodies that have not been conventionally mined; solution mining of conventional mines such as stopes leaching is included in Class V);
- ▼ Class IV - used to inject hazardous or radioactive waste into or above a formation which within one-quarter mile of the well contains a USDW or into or above a

formation which has been exempted pursuant to 40 CFR 146.04 (and therefore is unlikely to ever be used as a drinking water source); and

- ▼ Class V - wells not included in the above four classes.

All of these classes of wells must be authorized by permit or rule and no injection may be authorized if it results in movement of fluid containing any contaminant into a USDW (40 CFR Part 146). Existing Class IV wells that inject into a USDW have been phased out and new ones are prohibited (40 CFR 144.13).

Another significant provision of the SDWA's ground-water protection authorities is found in Section 1424, which establishes the process for designating "sole source aquifers." Areas in which an aquifer "is the sole or principal drinking water source for the area and which, if contaminated, would create a significant hazard to public health" may be designated a sole source aquifer area. Pursuant to the requirements of this provision, once an aquifer is established as a sole source aquifer, the federal government may not make any kind of financial assistance available for any project in the protection area of the aquifer, with the exception of monies that would be used to "plan or design the project to assure that it will not so contaminate the aquifer." Section 1427 of the Act also provides for a "Sole Source Aquifer Demonstration Program," under which states receive financial assistance for establishing sole source aquifer protection areas, and for developing plans to protect such areas. Regulations concerning one such program under this provision can be found at 40 CFR 149.

Provisions for wellhead protection were also adopted as part of the SDWA reauthorization. This legislation established a nation-wide program to encourage states to develop systematic and comprehensive programs within their jurisdictions to protect public water supply wells and wellfields from contamination. To date, twenty-nine states have submitted Wellhead Protection programs for review. Nine states have enacted enabling legislation.

6. Air Quality

The primary statute for preventing and controlling air pollution from mineral processing sites is the Clean Air Act of 1970, as amended in 1977 (42 USC §§ 7401-7626). The major goal of the Clean Air Act is to protect and enhance the quality of the nation's air resources so as to promote the public health and welfare and the productive capacity of its population.

In order to achieve its goals, the Clean Air Act establishes a framework to foster programs to prevent and control air pollution, provide technical and financial assistance to state and local governments in connection with the development and execution of air pollution prevention and control programs, and encourage and assist the development and operation of regional air pollution control programs.

Under the authority of the Clean Air Act, EPA has established primary and secondary national ambient air quality standards (NAAQS). Primary standards are intended to protect public health; secondary standards are intended to protect public welfare. NAAQS are established for particulates, sulfur oxides, carbon monoxide, ozone, nitrogen dioxide, and lead. Particulates and sulfur oxides are of special concern to the mineral processing industry.

States are required to prepare State Implementation Plans (SIPs) detailing a strategy for meeting primary NAAQS. SIPs will include emission limits for existing sources necessary to maintain or bring the area into attainment with the NAAQS. The SIPs must also include provisions for implementing the Prevention and Significant Deterioration (PSD) program for attainment and unclassifiable areas, and visibility protection for certain pristine areas. Once EPA approves and SIP, it becomes federally enforceable.

On July 1, 1987, EPA issued revisions to the national ambient air quality standards (NAAQS) for particulate matter (52 FR 24634). The revisions included the following four key changes:

- ▼ Replaced total suspended particulates (TSP) as the indicator for particulate matter for the ambient standards with a new indicator that includes only those particles with a nominal aerodynamic diameter less than or equal to 10 micrometers (PM_{10});
- ▼ Replaced the 24-hour primary TSP standard of $260 \mu\text{g}/\text{m}^3$ with a 24-hour PM_{10} standard of $150 \mu\text{g}/\text{m}^3$ with no more than one expected exceedance per year;
- ▼ Replaced the annual primary TSP standard of $75 \mu\text{g}/\text{m}^3$ with a PM_{10} standard of $50 \mu\text{g}/\text{m}^3$, expected annual arithmetic mean; and
- ▼ Replaced the secondary TSP standard of $150 \mu\text{g}/\text{m}^3$ with 24-hour and annual PM_{10} standards that are identical in all respects to the primary standards.

EPA recognizes the potentially large contribution of fugitive dust to total particulate matter in an area and created a fugitive dust policy in 1977 applicable to nonattainment areas for TSP. In this policy, EPA concluded that fugitive dust caused greater environmental impact in urban areas than in rural areas. EPA's lesser concern over TSP in rural areas is based on the following four factors: (1) the particulate matter consists of native soil which was believed to pose less of a health hazard than particles found in urban areas, (2) the population affected was small, (3) the economic base to support control was small, and (4) the cost of controlling miles of unpaved roads and acres of open land could be unreasonable. EPA's 1977 policy was that urban areas should receive the highest priority for development of programs for control of fugitive dust and programs in rural areas should focus on control of large existing manmade fugitive dust sources such as tailings piles and mining operations. In a notice on July 1, 1987 (52 FR 24716), EPA requested comments on three alternatives to the existing fugitive dust policy under consideration in response to the revised NAAQS. Until a revised policy is issued, EPA will continue to operate under the existing fugitive dust policy.

Any source with the potential to emit 250 tons per year or more of any air pollutant is considered a major emitting facility and is subject to the PSD program. Generally, one year of baseline air quality monitoring data is required before a PSD permit application is submitted. The application must demonstrate that emissions from the facility or modifications to a facility will not exceed the applicable increments or the NAAQS. The applicable increments are allowable increases in concentration of pollutants over a baseline concentration, but not to exceed the NAAQS.

Major stationary sources are required to apply the best available control technology (BACT) to pollutants that will be emitted in significant amounts [40 CFR 52.21(j)]. BACT may not be less stringent than new source performance standards (40 CFR Part 60) or National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR Part 61). Specific emissions standards are set forth under NESHAPs for inorganic arsenic emissions from primary copper smelters ($50 \mu\text{g}/\text{dscm}$) and for radionuclide emissions from elemental phosphorus plants. The NESHAP controlling radionuclides from elemental phosphorus plants only addresses stack emissions, not slag or other potential radionuclide sources.

New source performance standards (NSPS) are emission limits that have been set by EPA to apply to new or modified sources which may contribute significantly to air pollution. NSPS requirements apply to individual operations within a facility. NSPS are not permit requirements, but they do require that performance tests be conducted (40 CFR 60.7-60.8).

7. Wetlands Protection

Section 404 of the Clean Water Act authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits, after notice and opportunity for public hearing, for the discharge of dredged or fill material into the waters of the United States at specified disposal sites. The phrase "waters of the United States" has broad meaning and is defined in 33 CFR 328.3 as follows:

- ▼ All waters used or that may be used "...in interstate and foreign commerce;"
- ▼ "All interstate waters and their tributaries, including interstate wetlands;"
- ▼ "All other waters such as intrastate lakes, rivers, streams including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce..." including any such waters used for recreational purposes, fishing, or industrial purposes by industries in interstate commerce;" and
- ▼ "All impoundments of waters otherwise defined as waters of the United States," including tributaries of waters defined above, the territorial seas, and wetlands adjacent to waters defined above.

Certain discharges of dredged and fill material into waters of the United States are permitted under the "nationwide permit" system as defined in 33 CFR 330. Nationwide permits are designed to allow certain activities to occur with little, if any, delay or paperwork and are valid only if the conditions applicable to the nationwide permits are met. Authorized activities are typically those which have minimal direct or cumulative environmental impacts (33 CFR 323.2(h)). Specific authorized activities are identified in 33 CFR 330.5 and include, among others, seismic survey activity; structures for the exploration, production, and transportation of oil, gas, and minerals on the outer continental shelf within leased areas; and bank stabilization activities. According to 33 CFR 323.3, individual 404 permits are required for any discharges to waters of the United States not covered by (1) the nationwide permit program, or (2) for discharges not requiring permits, such as those which might occur as a result of farming, silviculture, and ranching (33 CFR 323.4(a)). Mineral processing activities that involve discharges of dredged or fill material to waters of the United States may require individual 404 permits from the Corps if: (1) the activity is not covered by a nationwide permit and (2) the activity is not exempt from regulation.

The Corps of Engineers must review applications for Section 404 permits in accordance with guidelines promulgated by the EPA Administrator under authority of Section 404(b)(1) of the Clean Water Act. The Section 404(b)(1) guidelines specify that "no discharge of dredged or fill material shall be permitted which will cause or contribute to significant degradation of the waters of the United States" (40 CFR 230.10(c)).

8. Other Applicable Federal Laws

The laws discussed below are not all directly relevant to the mineral processing industry, but may be important for certain operations or in the overall consideration of environmental impacts.

The National Environmental Policy Act

Enacted in 1969, the National Environmental Policy Act (NEPA), 42 USC 4341, requires that,

to the fullest extent possible, the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) all agencies of the Federal Government shall include in every recommendation or report on...major Federal actions significantly affecting the quality of the

human environment, a detailed statement...on (i) the environmental impact of the proposed action....

This requirement for preparation of an Environmental Impact Statement (EIS) establishes the framework and process by which EPA and the Council on Environmental Quality (CEQ) may impose the environmental protection requirements contained in all other federal environmental regulatory statutes on a wide variety of projects and activities. Environmental assessments must be prepared for any ore processing activities on federal lands, and similar activities that involve the use of facilities constructed with federal funds. EISs may be required for actions with significant impacts. CEQ regulations pertaining to the implementation of this law are found at 40 CFR Parts 1500-1508. EPA's corresponding regulations are found at 40 CFR 6. These requirements apply to Stauffer Chemical Company's elemental phosphorus facility in Silver Bow, Montana, Cyprus Mining Corporation's copper smelter in Claypool, Arizona, and Magma's copper smelter in San Manuel, Arizona, which are all located in National forests and Chevron Chemical Company's phosphoric acid plant in Rock Springs, Wyoming, which is on land owned by Bureau of Land Management, U.S. Department of Interior.

The Federal Land Policy and Management Act

The Federal Land Policy and Management Act of 1976 (FLPMA, 43 USC 1732, 1733, and 1782) authorizes the Bureau of Land Management (BLM) to regulate mining activities on its lands with respect to the environmental effects of such activities. Four of the facilities analyzed in this report are on lands owned by the federal government. The Bureau's regulations implementing this law (43 CFR 3809) are intended to prevent unnecessary or undue degradation of its lands, or lands that are under consideration for inclusion in the national wilderness system.

The regulations provide for reclamation of lands disturbed by mining and define three levels of mining operations. The first level, "casual use," applies to areas where mechanized earthmoving equipment and explosives are not used; a second level applies to surface disturbances of less than five acres per year; and a third level applies to disturbances of over five acres per year. For operations in the second level, operators must submit a letter or notice of intent; for operations on the third level, operators must submit a plan of operation that describes the proposed operation, including reclamation plans. Bonds are required when an operator has a record of noncompliance. These regulations apply to Chevron Chemical Company's phosphoric acid facility located in Rock Springs, Wyoming, which is situated on lands owned by BLM.

Forest Service Requirements

The Forest Service, U.S. Department of Agriculture, maintains regulations governing the use of the surface of National Forest System lands in connection with operations authorized by the United States mining laws. The regulations (36 CFR 228 Subpart A) are intended to "minimize adverse environmental impacts on National Forest system surface resources."

The regulations require that a "notice of intent to operate" be submitted by operators proposing to conduct prospecting or mining activities on Forest Service lands if the proposed activities might cause disturbance of surface resources. A proposed plan of operations is required if, in the judgment of the authorized Forest Service officer, operations would cause significant surface disturbance (e.g., if mechanized earthmoving equipment or explosives are to be used). All operations must minimize adverse environmental impacts to the extent feasible and must take into consideration federal, state, and local requirements concerning solid waste disposal and air and water quality. Consideration must also be given to the reclamation of disturbed lands. Reclamation bonds may be required by the authorized officer. These regulations also apply to the Stauffer Chemical Company plant in Silver Bow, Montana, and the Cyprus Mining Corporation's smelter in Claypool, Arizona, and Magma's copper smelter in San Manuel, Arizona.

Appendix D-2

**Existing Regulatory Controls
Addressing Mineral Processing Wastes
in Selected States**

Appendix D-2

Existing Regulatory Controls Addressing Mineral Processing Wastes in Selected States

EPA's goal in the analysis of state regulatory programs was to determine the current state regulatory status of the mineral processing wastes generated by the twelve commodity sectors addressed in the Report to Congress. The "State Regulation" section of each chapter (X.4.2) summarizes the findings of this analysis. This appendix presents the more detailed information upon which EPA based its review of and conclusions regarding state waste regulatory programs.

The analysis of state regulatory programs consisted of three steps. The first step focused on reviewing material in a report on state-level regulation of mining and mineral processing wastes ("CDM report").¹ The second step was to perform a more detailed review of individual state statutes and regulations. This step included the selection of a subset of states for further study. The final step in the analysis involved contacting state officials in the eighteen study states to clarify state regulations and obtain facility-specific information where possible. The three steps of the state regulatory analysis are summarized below.

First, EPA examined the material in the CDM report that pertains to all 29 states with one or more facilities considered in the Report to Congress, and summarized portions of the hazardous waste, solid waste, air quality, and water quality statutes and regulations that are relevant to the current disposition of the special study wastes. Although the CDM report provides a general overview of state statutory and regulatory requirements addressing wastes from the extraction, beneficiation, and processing of ores and minerals in all 50 states, it was not designed to provide the detailed analysis of the scope, and in particular, the implementation of regulations that address mineral processing wastes, that EPA believes is necessary for the Report to Congress.

The second step of EPA's analysis, therefore, was designed to provide more detailed information on the scope and implementation of mineral processing wastes. Time and resource constraints made it impossible to perform a detailed regulatory analysis on all of the states that contain facilities that generate a special mineral processing waste. Consequently, this step in the analysis involved selecting a representative sample of the 29 states for further analysis, in order to balance the need for comprehensive coverage of the mineral commodity sectors with the need to work with a manageable number of states.

To select a subset of states, EPA employed the following criteria: (1) the percentage of facilities in each state and in each sector covered by the regulatory analysis; and (2) the percentage of total waste volume generated by each waste stream and sector covered by the regulatory analysis. Exhibit D-2-1 of this appendix demonstrates the high percentage of facilities and total waste volume represented by the eighteen states chosen for further study, while Exhibit D-2-2 illustrates the location of these 19 study states.

Although this second step resulted in a detailed analysis of the statutes, regulations, and other information for each of the eighteen selected states, EPA found that the scope of state programs was not always made clear by the states' statutory and regulatory language. The final step of the analysis, therefore, consisted of calling state officials in order to learn how those statutes and regulations are interpreted in practice, and to obtain facility-specific implementation information where possible. The information compiled from these contacts was combined with the existing information on statutory and regulatory requirements to produce a final implementation analysis, which reviews the existing regulatory structure applicable to the 20 mineral processing wastes generated by the twelve commodity sectors considered in this Report to Congress.

¹ Camp, Dresser, and McKee Federal Programs Corporation (CDM). State Regulation of Solid Wastes from the Extraction, Beneficiation, and Processing of Non-Fuel Ores and Minerals, June 2, 1989. Prepared for U.S. Environmental Protection Agency, Office of Solid Waste; Document Control Number: T1142-ROO-DR-DELC-1.

Exhibit D-2-1 Summary of Results of Selection Criteria Evaluation

Sector	Total Number of Facilities	Number of Facilities in Study States	Percent of Facilities in Study States	Percent Waste Volume Generated in Study States	Notes on Volume Data ^(a)
Alumina	5	4	80	93	
Chromate	2	2	100	NA ^(b)	2 of 2 facilities CBI
Coal Gasification	1	1	100	100	
Copper	10	9	90	90	3 of 10 facilities CBI
Elemental Phosphorus	5	5	100	NA ^(b)	3 of 5 facilities CBI
Ferrous Metals	28	19	68	80	2 of 28 facilities CBI
Hydrofluoric Acid	3	3	100	100	1 facility NR ^(c)
Lead	5	4	80	NA ^(b)	3 of 5 facilities CBI
Magnesium	1	1	100	100	
Phosphoric Acid	21	20	95	100	2 of 21 facilities CBI
Titanium	9	5	56	NA ^(b)	8 of 9 facilities CBI
Zinc	1	1	100	100	

(a) CBI = Confidential Business Information

(b) NA = Insufficient data to calculate accurately due to Confidential Business Information (CBI) status

(c) A single hydrofluoric acid facility owned by duPont did not submit a survey response

The complete findings of this analysis have been included on a state-by-state basis in the remainder of this appendix.

Arizona

There are three copper processing facilities in Arizona under study for this report. The facilities, their locations, and the waste streams they generate are presented in Exhibit D-2-3. All three generate furnace slag, while only the facility in Hayden generates calcium sulfate sludge, and only the facility in San Manuel generates slag tailings.

Arizona adopts the Federal exemption from hazardous waste regulation for wastes from the extraction, beneficiation, and processing of ores and minerals. Arizona's Solid Waste Management Law and Solid Waste Rules include coverage for industrial wastes. According to State officials, however, the State's emphasis in implementing its regulations has been on municipal solid waste, especially with regard to the siting and construction of solid waste landfills. The State has not imposed regulations specifically regulating wastes from mining and mineral processing operations.

The implementation of Arizona's water quality control statutes and regulations affects mineral processing wastes more directly. As part of the State's initial ground-water protection efforts, all existing dischargers were required to submit notices of disposal. The State established priorities through the evaluation of these notices and proceeded to address them in order through its new Aquifer Protection Program. According to State officials, they are behind

schedule in permitting the numerous facilities. Permit requirements are based on the Best Available Demonstrated Control Technology (BADCT). Permit

exh D-2-2

Exhibit D-2-3
Mineral Processing Facilities Located in Arizona
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
ASARCO	Hayden	Copper	1. Slag 2. Calcium Sulfate Sludge
Cyprus	Claypool	Copper	1. Slag
Magma	San Manuel	Copper	1. Slag 2. Slag Tailings

requirements include liners and prescribed procedures for liner installation, consideration of treatment before discharge or disposal, and monitoring of all kinds, including ground-water monitoring and double liner leak detection. Surface impoundments, including holding impoundments, storage settling impoundments, treatment or disposal pits, ponds, lagoons, and mine tailings piles or ponds are specifically listed as discharging facilities that must be permitted. The State has inspection and enforcement authority through the Aquifer Protection Program and has utilized both of those authorities in the past.

The Arizona Rules and Regulations for Air Pollution Control adopt Federal new source and existing source performance standards for primary copper smelting operations. In addition, the regulations include fugitive dust limitation conditions for tailings piles and ponds.

The Hayden facility does not have an aquifer protection permit. The facility in Claypool received an aquifer protection permit in October 1989 for a tailings reprocessing unit; however, other operations at the facility, including hydraulic remining of old waste piles, are not currently subject to permit requirements. The facility in San Manuel has an aquifer protection permit for its heap leaching operation, but not for its tailings pond. According to State officials, the lack of permits at these facilities is attributed to the emphasis put on permitting new facilities, and to the long list of existing facilities that need to be permitted.

Delaware

There is only one mineral processing facility in Delaware that is under study for this report. The single facility is a titanium tetrachloride processing facility that generates chloride process waste solids. That facility, its location, and the waste stream it generates are presented in Exhibit D-2-4.

Exhibit D-2-4
Mineral Processing Facilities Located in Delaware
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
duPont	Edgemoor	Titanium Tetrachloride	1. Chloride Process Waste Solids

The Delaware Hazardous Waste Management Regulations specifically exclude wastes from the extraction, beneficiation, and processing of ores and minerals from regulation as hazardous waste. Therefore, chloride process waste solids from titanium dioxide production are not regulated as hazardous waste in Delaware.

The Solid Waste Disposal Regulations include in their definition of industrial waste, any substance resulting from the operation of or from any process of industry, manufacturing, trade, or business, or from the development of any natural resource. The regulations list specific design standards for on-site industrial landfills that include: analysis of the chemical and physical properties of the industrial waste; plans for leachate collection, treatment, and disposal systems; hydrological reports, including test borings to determine the soil and ground-water conditions; methods for venting and monitoring gases within the landfill; liners; and setback areas. Sanitary landfills have separate design and operating standards, most of which mirror those that apply to industrial landfills. One difference is the use of a toxicity test that must be applied to any non-municipal waste that is to be disposed in a municipal landfill. Industrial landfill permits specify which wastes can be accepted. Sanitary landfills, in contrast, tend to receive many different types of wastes; the toxicity test serves as a means of preventing hazardous wastes from being disposed of in these landfills. A new set of solid waste regulations was enacted in December 1989, and all the existing industrial landfills are in the process of coming under these requirements.

At present, all solid waste disposal facilities are required to submit either annual or quarterly reports assessing their compliance with their landfill permits. They also are required to submit closure plans that must include provisions for landfill capping, gas control, surface water run-off control, ground-water monitoring, and 30-year post-closure care. Although the State can and does conduct on-site inspections, it can only revoke a permit and deliver a cease action order. It cannot force remediation activities on the part of the facility.

Inactive or abandoned sites are sometimes passed over to the solid waste division from the State Superfund division. There are no official regulations concerning how the solid waste division must deal with these sites. The State is presently working under the authority of a policy paper that requires the present owner of the property to totally remove all pollutants from the site. There have been some legal challenges to this policy paper, but the State has been successful in the majority of the cases.

Delaware does have an approved NPDES program and continues to issue discharge permits for all point source discharges in the State. Permits for industrial wastewater discharges must require treatment that reflects, at a minimum, a practicable level of pollutant removal technology. Management practices required in the permits include specifications for monitoring of effluent levels and operating practices for the permitted facilities.

The titanium tetrachloride facility in Delaware under study for this report is the duPont facility in Edgemoor, DE. It currently generates chloride process waste solids, which are treated and landfilled. There is a surface impoundment on-site where the solids are co-managed with other wastes from the process. Initially, the facility had a solid waste permit for the on-site surface impoundment and for the process of allowing the chloride process waste solids to settle out to be eventually dredged and landfilled at another location. This landfill is on Cherry Island and is permitted separately as an industrial landfill. It is not clear from speaking with State officials whether the Cherry Island landfill is situated on land that is owned by the duPont company. The solid waste permit for the on-site impoundment was transferred to the Delaware Water Resources Division in early 1990, as were all surface impoundment permits currently in existence in the State. The Water Resources Division of the Delaware Department of Natural Resources and Environmental Conservation has yet to address the existing permit situation and has instructed duPont to continue operating under the terms of the solid waste permit until further notice. duPont also obtained a NPDES permit, which expires in September 1994, to discharge from the on-site surface impoundment. Requirements of the permit, in addition to the regimen of effluent monitoring from the four outfalls, include bio-monitoring procedures.

Florida

As shown in Exhibit D-2-5, there are 12 phosphoric acid facilities in Florida that are under study for this report. All 12 facilities produce both phosphogypsum and process wastewater.

Exhibit D-2-5
Mineral Processing Facilities Located in Florida
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Agrico	Mulberry	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
Central Phosphate	Plant City	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
CF Chemicals	Bartow	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
Conserv, Inc.	Nichols	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
Farmland Ind.	Bartow	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
Gardiner, Inc.	Riverview	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
IMC Fertilizer	Mulberry	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
Royster	Mulberry	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
Royster	Palmetto	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
Seminole Fertilizer	Bartow	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
US Agri-Chem	Ft. Meade	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
Occidental Chemical	White Springs	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum

The Florida Hazardous Waste Rules exclude "discarded material generated by the mining and chemical or thermal processing of phosphate rock and precipitates resulting from neutralization of phosphate chemical plant process and nonprocess waters" from regulation as hazardous waste. The rules incorporate by reference the Federal identification of hazardous waste, including the exemption for wastes from extraction, beneficiation, and processing of ores and minerals.

The Florida Solid Waste Disposal Facilities Regulations do not contain specific requirements pertaining to phosphogypsum stacks, though the State is currently drafting regulations to address them. The solid waste rules prohibit disposal except by sanitary landfill, incineration, recycling process, or "other approved method" consistent with the requirements of the rules. In the absence of express guidelines for stacks, the State has adopted modified landfill requirements, when appropriate, for regulation of phosphogypsum stacks. After considering ground-water monitoring data from facilities without liners under the stacks and from one facility with a stack liner, the Department of Environmental Regulation required liners for all new stacks and expansions of old stacks.

According to State officials, phosphoric acid facilities may have two types of permits for their solid waste disposal activities. Typically, old stacks have an Industrial Wastewater Discharge Permit. Under the 1988 Solid Waste Management Act, new facilities are required to obtain a solid waste disposal permit. Some facilities may have both.

Specific requirements for each facility are contained in the solid waste permit. The rules delineate site restrictions for solid waste disposal facilities (e.g., no disposal in an area subject to frequent and periodic flooding). Requirements in solid waste disposal permits may address location, performance standards (e.g., liner requirements), and operations (e.g., ground-water monitoring). Florida is currently in the process of developing operating and construction standards for stacks. There are no closure requirements for any of the units.

Currently, the existing cooling ponds for wastewater are not required to be lined. According to State officials, this will be addressed in the new regulations.

State officials have indicated that the Department has authority for on-site inspections and enforcement authority to issue administrative and consent orders. They do not, however, have authority to fine facilities for non-compliance. The Department must bring a facility operator to court to sue for damages. The mechanism for ground water cleanup is a CAPRAP or "contamination assessment report and remedial action plan."

Florida does not have an EPA-approved NPDES program. The Florida Wastewater Facilities Regulations incorporate by reference Federal "Effluent Guidelines and Standards for Mineral Mining and Processing" (40 CFR 436). The regulations contain standards (Title 17-6.310) that are more stringent than the Federal Guidelines. According to the State official, however, these regulations apply to mining of phosphate ore and not to processing. The cooling ponds associated with the phosphogypsum stacks are required to adhere to the design and operating standards for earthen dams in Title 17-9.

Because of ongoing modification to the solid waste regulations with regard to design and operating standards specific to phosphogypsum stacks and cooling ponds, the State official noted that the interim policy is to require any new or expansion of existing stacks or ponds to be lined and undergo formal closure. Under this policy, closure requirements include adequate cover to prevent infiltration, and run-off controls. The State may require remedial action by the owner/operator, which could be in the form of slurry walls or a ground-water recovery system.

According to the State official, all the ponds have run-on/run-off controls. The State has adopted the Federal Guidelines, which require controls to manage the storm water from a 25 year, 24 hour storm. Ground-water monitoring around the stacks also is required. According to the State official, the new stacks and ponds rarely need to discharge because of their huge capacity. All the phosphogypsum stacks and ponds, however, do have Federal NPDES permits in case there is a need to discharge to surface waters.

The State official related that the typical facility is comprised of a mine and an associated chemical plant. The mine will have its own Industrial Waste Permit, and the chemical plant also will have an Industrial Waste Permit. Therefore, a facility typically has 2 permits for disposal, each addressing its own discharge. An entire facility, however, typically only has one NPDES permit.

Under the Florida Air Pollution Rules, emissions from the phosphate industry are regulated. Rules exist for wet phosphoric acid production. According to a State official, phosphogypsum stacks and cooling ponds are not expressly mentioned in air permits. The basic concerns from these systems are fugitive dust and radon emissions. According to the State official, the stacks tend to "heal over," or crust. Fugitive dust and radon, therefore, have not historically been a concern for the air program. The State official related that the stacks are part of a wet system, which also helps to control potential dust emissions. Nonetheless, the operator of the Gardiner facility covered its old phosphogypsum stack with grass at closure in order to control future particulate emissions. This was, however, in response to a local rather than a State requirement.

Idaho

There are two phosphoric acid facilities and two elemental phosphorus facilities in Idaho that are under study for this report. The facilities, their locations and the waste streams they generate are presented in Exhibit D-2-6.

Exhibit D-2-6

Mineral Processing Facilities Located in Idaho and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Monsanto	Soda Springs	Elemental Phosphorus	1. Slag
FMC Corporation	Pocatello	Elemental Phosphorus	1. Slag
J.R. Simplot	Pocatello	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
Nu-West Industries	Soda Springs	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum

Under the Idaho Hazardous Waste Management Regulations, "solid waste from the extraction, beneficiation, and processing of ores and minerals, including coal, phosphate rock, and overburden from the mining or uranium ore" are exempt from regulation as hazardous waste.

According to State officials, phosphogypsum and process wastewater from phosphoric acid production are subject to neither the Idaho Solid Waste Law, nor the Idaho Solid Waste Management Regulations. No solid waste permits are required for disposal of mineral processing wastes. Idaho does ban the use of elemental phosphorus slag as construction material in habitable structures.

Idaho does not have a Federally-approved NPDES program. The Idaho Water Quality Standards and Wastewater Treatment Requirements regulate the State's waters based upon water use classifications. Non-sewage discharges must be treated to the extent necessary to ensure compliance with Sections 301 and 304 of the Federal Water Pollution Control Act.

Particulate matter emission limitations applicable to any process are given in the Air Pollution Control Regulations. According to State officials, the air permits do not contain specific requirements regarding phosphogypsum stacks, cooling ponds, and slag piles. The Simplot and Nu-West facilities are broadly responsible for "reasonable control of fugitives," but there is no express mention of stacks or ponds in the air permit.

Indiana

Four facilities generate special wastes from mineral processing in Indiana. Each of these facilities is a fully integrated ferrous facility generating iron and basic oxygen furnace steel slag and air pollution control dust and sludge. Exhibit D-2-7 shows the names and locations of the four ferrous facilities in Indiana.

Ferrous wastes (iron and steel slag and iron and steel air pollution control dust and sludge) are the only special wastes from the processing of ores and minerals generated in Indiana.

The Indiana Solid Waste Management Permit Regulations exempt from regulation:

- (13) The legitimate use of iron and steelmaking slags including the use as a base for road building, but not including land reclamation except as allowed under subdivision (15)...

Exhibit D-2-7
Mineral Processing Facilities Located in Indiana
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Bethlehem Steel	Burns Harbor, IN	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Slag 4. Basic Oxygen APC Dust/Sludge
Inland Steel	E. Chicago, IN	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Slag 4. Basic Oxygen APC Dust/Sludge
LTV Steel	Indiana Harbor, IN	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Slag 4. Basic Oxygen APC Dust/Sludge
US Steel	Gary, IN	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Slag 4. Basic Oxygen APC Dust/Sludge

(15) Other uses of solid waste may be approved by the commissioner if the commissioner determines them to be legitimate uses that do not pose a threat to public health and the environment (329 IAC 2-3-1).

State officials noted that, although this means that iron and steel slag may not be subject to regulation in a number of cases, this provision is interpreted cautiously and land reclamation or any use of slag would only be allowed with proof that no contamination of the environment could result.

APC dust and sludge is considered a special waste by the State of Indiana and may be only disposed off-site in one of twelve landfills designated to accept special waste, or in other landfills as determined on a case-by-case basis. Requests for disposal of special waste are matched by the State with a landfill or disposal site approved by the State. Generators generally indicate the landfills in which they would like approval to dispose of special waste. The EP toxicity test and the neutral water leaching test are used to determine the degree of hazard a waste may pose, and are part of an extensive application submitted to the State in order to determine suitable sites for disposal. Sites previously approved for solid waste disposal will be reviewed by the State under the authority of the proposed rule. Another provision of the proposed rule will require the State to issue certifications of special waste status to industry. The certifications will provide generators with a permit to dispose of waste at a landfill of their choice. Although the details of this provision are not established, industry could have a greater opportunity to select the most competitively priced waste management facility for disposal of special waste.

On-site disposal of APC dust and sludge, a practice used by both Inland and US Steel, was informally exempt from these requirements until February 1989, when a new rule regulating residuals went into effect. Although disposal of dust and sludge was informally monitored by State inspectors, facilities were not required to meet the standards of special waste landfills.

The new rule gave facilities until September of 1989 to file a notification to the State including basic information on the industrial process undertaken at the facility, what wastes were generated, including any available waste characterization data, and how the waste was managed at that time. After reviewing this material, State officials will conduct further waste characterization sampling and determine either 1) what types of off-site landfills these wastes may be hauled to, or 2) what type of restricted waste landfill permit these facilities would have to apply for. Permits for these

facilities will be called in on a schedule. By April 1990, three of the four iron and steel facilities in Indiana had filed the required notification.

Following determination of what type of site may accept the wastes as described in the facility notifications, sites must either meet the new requirements or close. Restricted sites will range from sanitary landfills, which must have ground-water monitoring wells, ten feet of clay barrier or a synthetic liner, and extensive evaluation by State officials, to the least restrictive landfill that may not even be required to have monitoring wells.

Existing sites that were required to close could, in the most stringent scenario, be required to be covered with two feet of clay and six inches of topsoil and vegetation, grade to a minimum slope and meet certain erosion control requirements through the placement of inert materials, in order to prevent pooling; establish monitoring wells; and possibly undertake a post-closure period of ten years that would include biannual ground-water monitoring, inspection and maintenance of cover, and financial assurance. Rule 9 of the regulation includes requirements on determining the type of waste to be disposed of; Rule 10 includes minimum design standards. State officials cautioned, however, that none of the waste management operations at any of the facilities had been classified at this time, and it was not possible to estimate exactly what requirements each facility would have to meet.

Waste management requirements under the new rule will be determined on a case-by-case basis, under the assumption that each material is somewhat different. Although the State may take enforcement action and exercise corrective action authority at any time when there is an imminent threat to human health and the environment, State officials were not able to estimate when waste management requirements established under the new rule would be established for each facility. Financial penalties of up to \$25,000 a day per violation are possible; the State is presently working on a penalty matrix.

In the case of inactive and abandoned sites, the State may require cover and leachate abatement activities, depending upon a determination of the potential threat to human health and the environment.

Requirements for ground-water controls vary by facility and by facility NPDES permit. A substantial amount of run-off from Bethlehem Steel may go to a lagoon system, although for the most part, slag piles are unlikely to be required to have run-off controls, according to a State official. Bethlehem is apparently built on a sandy base that prevents a substantial amount of run-off. The Inland and Armco facilities in Indiana, however, are required to have run-off controls for their slag disposal or management sites through the facilities' NPDES permits. Although most of the cooling water at US Steel is recirculated, some is blown-down, and excess is discharged with rain run-off from the slag piles. State officials indicated that circulating water at Inland dust and sludge impoundments is re-used and has been examined and demonstrated to pose no threat of water contamination.

Although the four primary steel mills in Indiana are required to submit fugitive dust program plans to the State, according to State officials, these plans have not been approved or disapproved. Steel mills must in general employ fugitive dust controls. The State, however, lacks extensive authority to require controls. The State has much more leverage when issuing construction permits to include air quality requirements, such as fugitive dust controls, than when issuing and re-issuing operating permits. To a large extent, local agencies have the primary responsibility for establishing requirements, extracting commitments to control emissions, and issuing permits. Thus, commitments to use dust suppression measures may be somewhat informal which makes any legal enforcement by the State difficult. In addition, facilities are then not bound by any enforceable requirement to continue air emission control measures under less than ideal conditions such as inclement weather or problems with vendors of dust suppression equipment.

Requirements for air quality control have been formally and informally arranged with the Bethlehem facility in Burns Harbor, and formally established through rulemaking for the US Steel facility in Gary. Most requirements for control of particulate matter emissions are established through rulemakings that specify requirements for a facility by name.

The steel industry and the State differ on whether it is the responsibility of the steel mills or the slag processors regarding dust suppression measures on slag that is to be re-processed. Certain slag processors have submitted dust suppression plans, though the State does not have the authority to require these plans, to approve or disapprove plans,

or to establish specific requirements. The State hopes to gain more significant regulatory control over the numerous slag processors operating at the site of the four primary steel mills.

Kentucky

Two facilities generate special wastes from mineral processing in Kentucky. One facility is a fully integrated ferrous facility generating iron and basic oxygen furnace steel slag and air pollution control dust. The other facility generates process wastewater and fluorogypsum from hydrofluoric acid production. Exhibit D-2-8 shows the names and locations of the two mineral processing facilities in Kentucky.

Exhibit D-2-8
Mineral Processing Facilities Located in Kentucky
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Armco, Inc.	Ashland	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Furnace Slag 4. Basic Oxygen Furnace APC Dust/Sludge
Atochem (Pennwalt)	Calvert City	Hydrofluoric Acid	1. Fluorogypsum 2. Process Wastewater

Two facilities in Kentucky generate wastes from the processing of ores and minerals. Armco generates ferrous wastes, and Atochem generates fluorogypsum and process wastewater from hydrofluoric acid production.

Mineral processing wastes are not subject to hazardous waste regulation in Kentucky. Certain solid waste management, water, and air regulations, as well as provisions in a proposed residuals rule, apply to ferrous wastes and hydrofluoric acid wastes similarly. To a large extent, however, these wastes are regulated on a site-specific basis.

Landfilling of solids is permitted under existing solid waste regulations. Kentucky officials have the authority to conduct inspections and enforcement activities, and to impose penalties for violations. Solid waste management facilities are required to have financial assurance for closure. Both ferrous wastes and hydrofluoric acid wastes may be regulated more strictly after the implementation of a residuals rule, which may be effective as early as the middle of July 1990. Landfills may be required to conduct additional ground-water monitoring and undertake formal closure activities under the requirements of the proposed residuals rule. In addition, the rule includes restrictions on the transportation of waste. Despite these general requirements, ferrous wastes and hydrofluoric acid wastes are primarily regulated on a site-specific basis.

Iron and steel slag and iron and steel air pollution control dust are managed separately and thus regulated differently in Kentucky. According to one State official and the Armco response to the SWMPF Survey, 100 percent of BF slag generated by the Armco facility in Ashland is sold to a processor (Heckett Co.) and 90 percent of steel slag is sold for processing, with the remaining ten percent returned to the sinter plant. According to another State official, slag which is not re-processed or otherwise used is disposed of in one of the two inert landfills Armco maintains on-site. These landfills are required to manage waste in an environmentally protective manner by employing and maintaining a monthly cover, operating according to a plan and permit, and using run-on and run-off controls and drainage ditches. Although State officials noted that there have been problems in the past with leaching of contaminants from slag use, the use of slag is not subject to regulation. If it is demonstrated that leaching has occurred because of the use of iron or steel slag, the facility could be cited, and enforcement through the waste management or water divisions could follow.

Regulation of air pollution control dust and sludge is somewhat more strict. The Armco facility disposes dust and sludge off-site at a residential landfill in Boyd County. Residential landfills are subject to requirements for ground-water monitoring.

The Atochem, Calvert City facility operates the only permitted "hydraulic landfill" (i.e., the facility's surface impoundment) in the State. The landfill is not designed to discharge to ground or surface water. Ground-water monitoring wells are located around the landfill (fluorogypsum pond) in accordance with the existing solid waste regulations. The fluorogypsum disposal site will be, after the promulgation of the proposed rule, regulated as a residual landfill. When renewing its solid waste permit, the facility will be required to obtain a permit for a residual landfill, continue to show that the waste is non-hazardous, and possibly upgrade the present ground-water monitoring operations. State officials noted that the material has a low permeability and that there is little possibility for contaminant transport. Even if there were no attenuation of contaminants, however, leachate would still not exceed point-source discharge limits, according to State officials.

State officials added that a CERCLA workforce is evaluating all closed landfills that were allowed to operate without permits, and that this investigation includes two sites at the Calvert City facility.

Water protection requirements in Kentucky apply similarly to both Armco and Atochem, although hydrofluoric acid process wastewater is the only waste stream subject to specific controls. At this time, the Atochem facility has a NPDES permit for discharge of process wastewater (State officials believe, however, that 100 percent of hydrofluoric acid process wastewater is recycled at the Atochem facility). Dikes located around the fluorogypsum pond provide some run-off control.

In order to obtain a NPDES permit, the hydrofluoric acid process wastewater or any iron and steel plant discharges must be characterized, and this information must be submitted to the State. The permit application also must include the flow rate, how much effluent is discharged, the mixing zone of the effluent, the size of the stream to which effluent will be discharged, the pH, and the concentration of suspended solids.

Permitted facilities operate under a self-monitoring system and must submit reports on effluent on a periodic basis, ranging from several times daily to monthly. Each facility has an average and maximum value it must achieve. Permits are in effect for five years unless a facility undergoes modification. Permits are drafted by the Kentucky ground-water branch and then subject to a 30 day public comment period. After final review and modification, permits are issued in final form.

The Atochem facility must meet standards for stormwater run-off from its operating and closed fluorogypsum ponds. Similarly, it is likely that Armco must meet standards for stormwater run-off from any slag piles or APC dust and sludge waste piles or surface impoundments. Kentucky officials monitor surface water discharges and impacts to ground water. The facility must divert stormwater to prevent contamination of ground or surface water and monitor these discharges for hazardous characteristics using a chemical measuring device. Some facilities, including the Atochem and Armco, may also do toxicity testing using aquatic organisms; this test would apply mainly to process wastewaters. The Atochem facility recently renewed its permit, which includes human health and aquatic life discharge limits.

The nature of the ferrous wastes results in stricter fugitive dust requirements for the Armco facility than for management of the predominantly liquid hydrofluoric acid wastes at the Atochem facility. Facilities such as Atochem must meet general requirements regarding fugitive dust. Requirements are based on visual observation and rely on the discretion of the inspector, according to State officials. The Calvert City facility has certain fluorospar kilns and waste piles that it may be required to revegetate, although State officials were not aware of any fugitive dust problems at the facility. As stated above, the nature of fluorogypsum as currently managed effectively precludes any fugitive dust problems.

Strict air pollution controls are employed at the Armco facility to prevent fugitive dust emissions. At the time when slag is tapped from the blast furnaces, the molten slag is hit with "big sprays." The slag is dumped into a two and one-half ton end loader, which then goes through a truck watering station where the slag is "quenched." The trucks then travel along an oiled road surface (another dust suppression mechanism) to the Heckett processing facility. A controlled precipitator captures dust from each of the basic oxygen furnaces, which is then hauled in covered trucks to a private

landfill. Blast furnace air pollution control waste is eventually hauled to the same landfill, yet is apparently generated as a sludge which is hauled to ponds and then loaded into trucks. Kentucky air officials have the authority to inspect the Armco facility and do so on a regular basis.

Louisiana

In Louisiana, there are two alumina facilities, one hydrofluoric acid facility, and three phosphoric acid facilities, as shown in Exhibit D-2-9.

Exhibit D-2-9
Mineral Processing Facilities Located in Louisiana
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Agrico	Donaldson	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
Agrico	Uncle Sam	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
Arcadian	Geismar	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum
Kaiser	Gramercy	Bauxite	1. Red and Brown Muds
ORMET	Burnside	Bauxite	1. Red and Brown Muds
Allied-Signal	Geismar	Hydrofluoric Acid	1. Process Wastewater 2. Phosphogypsum

The Louisiana Hazardous Waste Management Regulations exclude "solid waste from the extraction, beneficiation, and processing of ores and minerals, including coal, phosphate rock, bauxite, and overburden from the mining of uranium ore" from regulation as hazardous waste.

In Louisiana, phosphogypsum and process wastewater from phosphoric acid production, fluorogypsum and process wastewater from hydrofluoric acid, and red muds from alumina production are considered industrial wastes and are subject to the requirements of the Louisiana Solid Waste Management and Resource Recovery Law and the Louisiana Solid Waste Regulations. The regulations outline general site requirements for all solid waste disposal facilities, including provisions for soils (e.g., stability, low permeability), hydrological characteristics, locational characteristics (e.g., proximity to critical environmental areas), security, safety, and monitoring of incoming wastes.

According to a State official, there are no express requirements in the regulations for phosphogypsum stacks or fluorogypsum stacks. Instead, they are subject to the majority of the industrial solid waste landfill requirements of the solid waste regulations. The stacks are not required to adhere to the daily cover requirements for landfills. Phosphogypsum stacks are required to have controls that contain run-off from operating areas. According to a State official, liners are required for new impoundments and stacks; "new" applies to facilities built after July, 1983. During closure, the owner or operator is required to emplace either a final cover or alternative erosion control measures if installation of a final cover is infeasible. The owners/operators must meet financial responsibility requirements for closure and post-closure care.

The impoundments that receive the process wastewaters and red muds must adhere to specific requirements for surface impoundments outlined in the regulations. Under these requirements, owners or operators must ensure that each surface impoundment has the following: controls so that surface run-on will be prevented from entering the facility;

an artificial or natural liner on the bottom and sides of the impoundment which is equivalent to three feet of clay with the coefficient of permeability of 1×10^{-7} cm/sec for ground-water protection; design and operation standards that prevent overtopping by overfilling, wave action, or storms; a perimeter levee to minimize wind and water erosion; and weekly inspections. Ground-water monitoring around the impoundments is required. For surface impoundments, samples must be analyzed for total dissolved solids, plus three other parameters intrinsic to the waste source. The liner requirement applies to "new" surface impoundments (i.e., those built after July, 1983).

Closure and post-closure care requirements for surface impoundments also are addressed in the regulations. The impoundments must be dewatered. If the remaining solids are removed, no other closure or post-closure care requirements apply. If solids remain in the impoundment, owners/operators must adhere to the closure and post-closure requirements for industrial solid waste landfills. Owners/operators must meet financial responsibility requirements for closure and post-closure care of surface impoundments.

Permits are required in order to construct a new facility or make major modifications to an existing facility. An interim permit may be issued to the operator of an existing facility (any facility collecting or receiving solid waste and not closed prior to January 20, 1981) while an application is being processed, or while a facility or site is being modified. According to the State official, the permit application, after review, essentially becomes the permit. If the Department disagrees with something in the application, the Department attaches conditions to the application that must be met. The Arcadian facility and the two Agrico facilities that produce phosphoric acid, the Allied Signal hydrofluoric acid facility, and both the Kaiser and ORMET alumina facilities have "standard permits," which means each facility has fulfilled all of its permitting obligations and met all the requirements of the regulations. According to the State official, the ORMET facility has a standard permit for its red mud lake and two red mud impoundments are being closed. The State official explained that when the Department of Environmental Quality considers bringing a facility into the program, it has two options for a unit, including upgrade or closure. If the State determines that it is not worthwhile to upgrade units, these units typically are closed.

The Department has on-site inspection authority. The authority for administrative and enforcement activity is outlined in the Environmental Quality Act, Sections 212 and 225. The Department can issue consent orders, administrative orders, and notices of violation, depending on the nature of the problem. As an example, the State official noted that if the Department notices an activity it wants changed, even if that activity does not necessarily constitute a violation, it may issue a consent order.

Because Louisiana does not have an EPA-approved NPDES program, Federal NPDES permits are required for surface water discharges. All three phosphoric acid facilities in Louisiana have NPDES permits. The Allied-Signal facility discharges to the Mississippi River through permitted NPDES outfalls. In addition, under the Louisiana Water Pollution Control Regulations, a permit from the State is required in order to discharge leachate or run-off to surface waters from facilities. Permits are administered through the Louisiana Water Discharge Permit System.

The Louisiana Air Pollution Control Regulations (LAPCR) regulate and control the discharge of emissions into the air resources of the State and incorporate the Federal New Source Performance Standards. Louisiana also has adopted the Federal primary and secondary ambient air quality requirements. All facilities are required to obtain a Louisiana Air Emissions Permit, which contains site-specific requirements based on the regulations and the New Source Performance Standards. According to a State official, a facility must be operated in a manner to minimize fugitive dust. If any phosphoric acid, hydrofluoric acid, or alumina facility were to have a potential problem with dust from either a stack or impoundment, the owner or operator would be required to remedy that problem. Options for fugitive dust control are outlined in the regulations and include, among other things, application of chemicals, asphalt, or water.

Mississippi

There are three mineral processing facilities in Mississippi that are under study for this report: two titanium tetrachloride facilities that generate chloride process waste solids, and one phosphoric acid processing facility that generates process wastewater and phosphogypsum. The facilities, their locations, and the waste streams they generate are presented in Exhibit D-2-10.

Exhibit D-2-10
Mineral Processing Facilities Located in Mississippi
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
duPont	Pass Christian	Titanium Tetrachloride	1. Chloride Process Waste Solids
Kerr-McGee	Hamilton	Titanium Tetrachloride	1. Chloride Process Waste Solids
Nu-South Industries	Pascagoula	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum

The Mississippi Hazardous Waste Management Regulations adopt the Federal exemption for wastes from the extraction, beneficiation, and processing of ores and minerals from hazardous waste regulation. Therefore, chloride process waste solids are not regulated as hazardous waste in Mississippi.

The Mississippi Solid Waste Management Regulations contain a provision that exempts solid wastes generated and processed on the generator's property, in a processing facility owned and operated by the generator, from regulation as solid waste [MSWMR Sec. A(2)(f)]. The focus of solid waste regulation implementation has been on municipal solid waste and hazardous waste. There are requirements for solid waste landfills, including liners, ground-water monitoring, and erosion and ponding control. Apart from this focus on municipal solid waste and hazardous waste, the State policy is to allow generators of non-hazardous industrial waste to dispose of the waste on-site without a permit as long as the method of disposal does not create an environmental or public health hazard. The State can and does conduct on-site inspections, and has in some cases required industrial solid waste generators to obtain permits for the disposal of their wastes.

The State does have an approved NPDES program. In addition to NPDES permits for all point source discharges in the State, the State also issues UIC permits, and State permits for discharges to pretreatment works, treatment works where no discharge occurs, and generally where NPDES and UIC permits do not apply. These regulations cover all discharges from industrial facilities, including mineral processing facilities.

The two titanium tetrachloride facilities in Mississippi under study for this report are the duPont facility in Pass Christian, MS and the Kerr-McGee facility in Hamilton, MS. The duPont facility, which uses the chloride-ilmenite process, treats its chloride process waste solids in an on-site surface impoundment and disposes of them in on-site waste pits. It has no solid waste permit for this process or for disposal. It does have a NPDES permit for discharge to surface water from large storage ponds that collect contact cooling water from the production process and surface run-off from all the disposal pits and surface impoundments at the facility. In the past, there had been ground-water monitoring wells on-site, but they are not mandated by the NPDES permit and may not currently be used. The facility is required to monitor the constituent concentrations of its effluent on a regular basis. The Kerr-McGee facility uses the chloride process, and generates process wastewater and chloride process waste solids. The facility has no solid waste permit addressing its co-management of these wastes on-site. Although this facility's NPDES permit closely resembles that of the duPont facility, Kerr-McGee is permitted to discharge its process wastewater while duPont is not. The duPont facility currently injects its process wastewater into the ground via three on-site deep wells.

The phosphoric acid production facility in Mississippi under study for this report is the Nu-South Industries facility in Pascagoula, MS. This facility was recently purchased by Nu-South Industries from Mississippi Chemical Company, which had operated the facility for over 30 years. Since the purchase, the facility has not been in operation and Nu-South has, in fact, filed for bankruptcy. There were no solid waste permits for the facility, but its NPDES permit was transferred to the new ownership. This permit is still in effect, but the only management activities regarding the surface impoundment atop a large phosphogypsum stack which remains at the site are carried on with money provided to the trustee of the facility by Mississippi Chemical Company. According to State officials, inactive or abandoned

industrial sites with non-hazardous waste are regulated only in response to demonstrated public health or environmental hazards.

Missouri

Three facilities generate special wastes from mineral processing in Missouri. Each of these facilities generates lead slag. Primary lead slag is the only special waste from the processing of ores and minerals generated in Missouri. Exhibit D-2-11 shows the names and locations of the three lead facilities in Missouri.

Exhibit D-2-11
Mineral Processing Facilities Located in Missouri
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Asarco	Glover	Lead	1. Slag
Doe Run	Herculaneum	Lead	1. Slag
Doe Run	Boss	Lead	1. Slag

Historically, lead slag has not been regulated under either hazardous waste or solid waste rules in Missouri. The Metallic Minerals Waste Management Act passed in 1989, (HB 321), requires generators of lead slag to submit a permit application for management of a number of mining and mineral processing wastes, including lead slag. Permits for existing operations, which were due by February 28, 1990, must include the following: 1) operating information such as maps, proof of ownership, time tables, and location of monitoring wells; 2) a detailed closure plan (and post-closure plan, if applicable), including information on recommended future land uses and plans for revegetation to fit the local environment; 3) an inspection and maintenance plan; and, 4) provisions for financial assurance. Closure plans must be reviewed every five years; plans must include provisions for inspection by State officials. Only active sites are subject to the requirements of the Act; old and abandoned sites are specifically excluded.

Until regulations are developed to implement the Act, owners are not required to meet specific criteria or management requirements beyond the requirement to submit closure plans as described above. The statute contains provisions for enforcement such as injunction and civil penalties. Because the first permitting cycle has not yet been completed, these provisions have not been tested through the failure of a facility to comply with the requirements, or expanded through development of regulations.

In Missouri, owners and operators must obtain a NPDES permit for storm water discharges from slag piles. Therefore, all slag piles should be equipped with run-on/run-off controls. In addition, although lead smelting facilities are required to obtain air quality permits, specific requirements are not included for slag piles. Any dust suppression measures undertaken by facilities are optional.

Montana

Two facilities generate special wastes from mineral processing in Montana. One of these facilities generates lead slag from primary lead production. The other facility generates elemental phosphorus slag. Exhibit D-2-12 shows the names and locations of the two mineral processing facilities in Montana.

Exhibit D-2-12
Mineral Processing Facilities Located in Montana
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Asarco	East Helena	Lead	1. Slag
Stauffer	Silver Bow	Elemental Phosphorus	1. Slag

Two special wastes from the processing of ores and minerals, lead slag and elemental phosphorus slag, are generated by facilities located in Montana. Regulation of lead and elemental phosphorus slag is virtually identical because both wastes are slags and mineral processing waste is not subject to extensive regulation in the State.

Montana has adopted the Federal exclusion from hazardous waste regulation for wastes from the extraction, beneficiation, and processing of ores and minerals.

According to State officials, the Montana solid waste regulations exempt from licensing wastes that are managed on-site. Thus, although lead and elemental phosphorus slags are considered solid waste, as long as slag is managed on-site, a slag pile would not be subject to regulation unless it causes a nuisance or provokes a health hazard. If lead or elemental phosphorus slag were managed off-site, the off-site facility would be subject to solid waste management requirements such as licensing.

Montana does not regulate storm water discharges from slag piles under water quality standards; NPDES permits are not required and slag piles are apparently not required to have run-on/run-off controls. In addition, no surface water or ground-water protection requirements appear to apply to lead slag disposal units.

Although both lead and elemental phosphorus facilities in Montana are required to obtain air quality permits, specific requirements are not included for slag piles. Any dust suppression measures undertaken by facilities related to slag are optional.

New Mexico

There are two mineral processing facilities in New Mexico that are under study for this report. The two facilities are copper processing facilities. Both of the facilities produce furnace slag from copper processing, but neither produce slag tailings or calcium sulfate sludge. The facilities, their locations, and the waste streams they generate are presented in Exhibit D-2-13.

Exhibit D-2-13
Mineral Processing Facilities Located in New Mexico
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Phelps Dodge	Hurley	Copper	1. Slag
Phelps Dodge	Playas	Copper	1. Slag

The New Mexico Hazardous Waste Management Regulations adopt the Federal exemption from hazardous waste regulation for wastes from the extraction, beneficiation, and processing of ores and minerals. Consequently, none of the three special wastes from primary copper processing are regulated as hazardous wastes.

The New Mexico Solid Waste Management Regulations initially defined industrial waste as waste in the nature of residential, commercial or institutional waste generated at an industrial establishment, but not waste resulting from the industrial process. Subsequently, a new set of solid waste regulations was enacted in March 1990. The new regulations specifically exempt wastes from the extraction, beneficiation, and processing of ores and minerals from solid waste regulation.

The New Mexico Environmental Improvement Division is empowered by the New Mexico Water Quality Standards and the New Mexico Water Quality Regulations to establish effluent limitations, to require the highest and best degree of wastewater treatment available to protect the designated uses of State waters, and to enforce both State and EPA discharge permit conditions. The State does not have an approved NPDES program. All persons who may cause or allow effluent or leachate to discharge so that it may move directly or indirectly into the ground water must have a discharge plan approved by the Division. The plans are evaluated on the basis of their adequacy in meeting ground-water quality standards. There are several mining and mineral processing-related exceptions from the universal discharge plan requirement including leachate from the direct natural infiltration of precipitation through disturbed materials (unless the State determines a public health hazard would result) and leachate that is otherwise regulated by the Solid Waste Management Regulations. The State can and does conduct on-site inspections and enforcement actions, including remediation activities. The New Mexico Air Quality Standards and Regulations require all sources of air contaminants to have a permit in order to operate. Although emission limitations for a variety of mineral processing operations are specified, copper processing is not mentioned specifically.

The slag generated at both the Hurley and Playas facilities is not covered under any provision of the State's solid or hazardous waste regulations. Both facilities have discharge plans for protection of the ground water, but the plans do not address slag disposal.

North Carolina

North Carolina has one sodium dichromate facility and one phosphoric acid facility, as shown in Exhibit D-2-14.

In its Hazardous Waste Management Regulations, North Carolina adopts the Federal definition of hazardous waste, and as a result, "solid waste from the extraction, beneficiation and processing of ores and minerals (including coal), including phosphate rock and overburden from the mining of uranium ore" are exempt from regulation as hazardous waste in North Carolina.

Exhibit D-2-14
Mineral Processing Facilities Located in North Carolina
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Occidental Chemical	Castle Hayne	Chromite	1. Roast/Leach Ore
Texasgulf	Aurora	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum

According to State officials, all residuals from facilities with NPDES permits are exempt from the North Carolina Solid Waste Management Act and pursuant regulations.² Instead, these wastes are regulated under "non-discharge" permits under the North Carolina Water Pollution Regulations. Under these regulations, a NPDES permit is required to discharge wastes from an outlet, point source, or disposal system into State surface waters. North Carolina has an EPA-approved NPDES program.

North Carolina has issued non-discharge permits to Occidental's chrome facility that require zero discharge from the impoundments used for disposal of the treated residue. In addition, the permit requirements include weekly EP toxicity testing, ground-water monitoring, a compliance boundary where water quality standards must be met, and operation by personnel certified by the State.

For the Texas Gulf facility, much of the disposal activity is addressed under the mining regulations. From 1963 until about two and one half years ago, Texas Gulf placed its phosphogypsum in permanent stacks. According to the State official, they currently stack the phosphogypsum only temporarily. The phosphogypsum is then transported and mixed with clay and sand tailings and put back into mined-out areas. This activity is done under the facility's mining permit. According to the State official, it is Texas Gulf's position that phosphogypsum is not a waste, but rather a by-product. Therefore, the phosphogypsum stacks, both new and old stacks, are not considered waste piles by the Solid Waste Section, and historically, have not been regulated as such. According to the State official, if these stacks fell within the jurisdiction of the solid waste program, the low pH that they exhibit might result in their regulation as hazardous wastes.

According to the State official, North Carolina has adopted Federal effluent limitations guidelines which designate the phosphoric acid process as "closed loop," stipulating that it may not result in any discharge. The Water Quality Section uses best professional technical judgments and best available technology to achieve zero discharge. If zero discharge cannot be achieved, however, the phosphoric acid facilities must abide by State standards for ground water and surface water, as outlined in the North Carolina Water Quality Standards (15 NCAC 2B.02 and .01). These regulations do not allow degradation of the State's waters below water quality levels necessary for existing and future uses.

In all instances, for phosphoric acid facilities, treatment or discharge of wastewater is handled by discharge permits. As noted, North Carolina has an EPA-approved NPDES program. Under the North Carolina Water Pollution Control Regulations, a NPDES permit is required to discharge wastes from an outlet, point source, or disposal system into State surface waters.

The Water Quality Section of the Division of Environmental Management has the primary jurisdiction for the disposal of phosphogypsum and process wastewater from phosphoric acid production and treated roast/leach ore

²The North Carolina Solid Waste Management Regulations state that the term solid waste does not include "wastewater discharges and the sludges incidental thereto and generated by the treatment thereof which are point sources subject to permits granted under Section 402 of the Federal Water Pollution Control Act, as amended (P.L. 92-500) and permits granted under G.S. 143-215.1 by the Environmental Management Commission; except that any sludges that meet the criteria for hazardous waste under the Federal Resource Conservation and Recovery Act (P.L. 94-580) as amended, shall also be a solid waste" [NCAC, Title 10, Chapter 10G, Section .0101(36)(iii)].

residue from sodium dichromate production. This office has the authority to perform on-site inspections. North Carolina General Statute (143-215.2) addresses and authorizes different types of "special orders," including Consent Orders.

A State official described a situation at Texas Gulf in which a Consent Order was issued. Depressurizing water for the mine flowed through the stacks. As it passed through one of the ditches around the phosphogypsum, the water became contaminated with fluorides and phosphorus. The Water Quality Section issued a Consent Order. Texas Gulf subsequently "closed the loop" (except for the disposal of cooling water in ponds) to ensure no mingling of waters. Texas Gulf also was required to line all their ditches. As a result of ground-water problems from the ponds and the stacks, another Consent Order was issued. Texas Gulf claims that their ponds are already lined. To address the problem, therefore, they are installing a slurry wall of salted bentonite around these ponds to stop lateral movement to surface water.

A liner or impervious layer is required under all new phosphogypsum stacks in order to reduce migration. At the Texas Gulf facility, according to the State official, no areal expansion of stacks is occurring; instead, the old stacks are typically being drawn down.

Under the North Carolina Air Pollution Control Regulations, the State has adopted the Federal standards for ambient air quality and new source performance standards. According to a State official, the Texas Gulf facility has 21 air permits, none of which specifically mention or address the stacks or ponds. Because the material in gypsum stacks forms a crust, State officials believe that the stacks have not posed a major dust problem, and they have not been actively subject to requirements in the air program. Currently, Occidental's surface impoundment used for disposal of the treated roast/leach residue is not subject to specific requirements in the facility's air permit.

In the future, however, the State official mentioned a recently promulgated air regulation that may affect the phosphogypsum stacks and ponds and chrome waste impoundments. When Texas Gulf or Occidental modifies its facility and applies for a new permit, the stacks or impoundments may become subject to more stringent air regulation under the Control of Toxic Air Pollutants (15A NCAC 2D Section .1100) and the permitting requirements for toxic air pollutants (15 NCAC 2H Section .0610). This regulation addresses certain air toxics, including radionuclides and fluorides, which can be released as air contaminants from phosphogypsum stacks and ponds.

North Dakota

As seen in Exhibit D-2-15, the Dakota Gasification facility in Beulah, North Dakota is the only facility in the State under study for this report.

Exhibit D-2-15 Mineral Processing Facilities Located in North Dakota and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Dakota Gas	Beulah	Coal Gasification	1. Process Wastewater 2. Gasifier Ash

Under the North Dakota Hazardous Waste Management Act, "solid waste from the extraction, beneficiation, and processing of ores and minerals, including phosphate rock and overburden from the mining of uranium ore" is exempt from regulation as hazardous waste. North Dakota has an EPA-approved RCRA Subtitle C program.

The North Dakota Solid Waste Management Regulations delineate standards for several disposal operations, including sanitary landfills, incinerators, special use disposal (i.e., construction and demolition wastes and incineration residue), and other methods of disposal. The North Dakota State Department of Health and Consolidated Laboratories, in its comment on the September 25, 1989 proposed mineral processing rule (54 FR 39298), stated that wastes from the

Dakota Gasification facility are regulated as "special wastes" (i.e., special use) under the State's Solid Waste Management and Land Protection Act and the Solid Waste Management Regulations.³ According to a State official, the Department is given broad authority under the Act to implement the pursuant rules, so long as its actions are within the intent of the Act.

Under authority of the Special Use Disposal Standards (33-20-05-02), the Department of Health determines the appropriate requirements for each site and outlines them in a permit. Permits are required in order to construct (33-20-06-08) and operate (33-20-07-01) a solid waste disposal facility. The State official described three permitted disposal facilities, two landfills for gasifier ash, one of which is closed, and one for construction debris. The ash landfills are required to have liners. The ash landfill currently in use has a synthetically lined run-off system and a tiled drain system on the up-gradient side, outside of the pit.

One ash landfill has been closed, and the "permit is under post-closure." According to a State official, at the time of closure the permit is amended and post-closure requirements are attached. Closure requirements include eight feet of cover, where the lower three feet are of compacted clay. Post-closure requirements include general maintenance and ground-water monitoring.

The facility's four ponds do not have permits, although proposed rules (see below) would require them. At the time of the plant's construction, it was unclear whether the process waters would exhibit hazardous characteristics, and subsequently which regulations would apply. The State official noted that a conservative approach was taken and liners and other engineered controls were used.

The Department of Health has right-of-entry authority to conduct on-site inspections, issue administrative orders (e.g., the Director may issue a Directive in emergency situations), enter into consent agreements, and take civil or criminal action.

North Dakota is currently in the process of amending its solid waste regulations. The proposed changes include specific requirements for surface impoundments, including permitting requirements, and express post-closure care activities for all disposal facilities. Neither the current rules nor the amendments have express financial responsibility requirements.

The North Dakota Water Pollution Control Act establishes the requirements for treatment of industrial wastes. The North Dakota Water Quality Standards require that no untreated industrial wastes which contain substances harmful to the public or which would degrade water quality can be discharged into the State's waters. The North Dakota Pollution Discharge Elimination System Regulations establish procedures for application, issuance, denial, modification, and revocation of permits for discharging pollutants into the waters of the State. North Dakota participates in the National Pollutant Discharge Elimination System (NPDES). NPDES permit holders are required to comply with Federal effluent limitations and other applicable requirements of the Water Pollution Control Act.

The North Dakota Air Pollution Control Rules (NDAPCR) establish air quality standards and emission requirements necessary to maintain air quality. NDAPCR outlines ambient air standards similar to Federal standards, except for the sulfur oxides standard, which is more stringent. The rules include provisions for restriction of particulate matter from industrial processes. Permits are required in order to construct and operate air contaminant sources. According to State officials, the air permit for the Dakota Gas facility does not directly address the waste management units.

³ North Dakota State Department of Health and Consolidated Laboratories, MW2P-00002, Public Docket MW2P-FFFFF, U.S. EPA.

Ohio

Eight facilities generate special wastes from mineral processing in Ohio. Seven of these facilities are fully integrated ferrous facilities generating iron and basic oxygen steel slag and air pollution control dust and sludge (Wheeling-Pittsburgh, Steubenville did not generate steel wastes in 1988). The other facility generates titanium tetrachloride process waste solids. Exhibit D-2-16 shows the names and locations of the mineral processing facilities in Ohio.

Exhibit D-2-16
Mineral Processing Facilities Located in Ohio
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Armco	Middletown	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Furnace Slag 4. Basic Oxygen Furnace APC Dust/Sludge
LTV Steel	E. Cleveland	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Furnace Slag 4. Basic Oxygen Furnace APC Dust/Sludge
LTV Steel	W. Cleveland	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Furnace Slag 4. Basic Oxygen Furnace APC Dust/Sludge
US Steel	Lorain	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Furnace Slag 4. Basic Oxygen Furnace APC Dust/Sludge
Warren Steel	Warren	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Furnace Slag 4. Basic Oxygen Furnace APC Dust/Sludge
Wheeling-Pittsburgh Steel	Steubenville	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge Steubenville did not generate steel wastes in 1988
Wheeling-Pittsburgh Steel	Mingo Junction	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Furnace Slag 4. Basic Oxygen Furnace APC Dust/Sludge
SCM	Ashtabula	Titanium	1. Titanium Tetrachloride Process Waste Solids

Seven facilities in Ohio generate ferrous wastes; one facility generates titanium tetrachloride process waste solids.

Ohio adopts the special exemption for wastes from the extraction, beneficiation, and processing of ores and minerals. Therefore, neither the special ferrous wastes nor chloride process waste solids from the production of titanium tetrachloride are regulated as hazardous wastes in Ohio.

According to the Ohio Solid Waste Disposal Regulations, slag is not a solid waste, and therefore slag from iron and steel production is not regulated as a waste under Ohio waste management rules. The re-use of slag, however, may be subject to specific statements or requirements.

Despite Ohio's adoption of the special waste exclusion, State officials indicated that iron and steel APC dust or sludge as well as titanium chloride process waste solids could be regulated as a hazardous or solid waste, depending on the results of EP toxicity tests. Assuming that in most instances hazardous waste regulation is avoided through the special exemption, ferrous APC dust and sludge and titanium chloride process waste solids would be regulated as solid waste. State officials explained that they use a strict interpretation of solid waste, and that all wastes that are not hazardous or are not specifically excluded by the solid waste regulations, such as slag, are regulated as solid waste. Thus, ferrous APC dust and sludge and titanium tetrachloride process waste solids are regulated as solid, non-hazardous wastes according to State officials.

Generators of solid waste are authorized to dispose of their waste in one of three ways: incineration, landfill disposal, or composting. If wastes are incinerated on-site, then the facility does not need a permit. Water pollution control regulations apply to some aspects of the land application of sludges. Ohio has no specific storage requirements for non-putrescible wastes; thus, the storage time for these wastes is open-ended, according to State officials.

If APC dust and sludge or titanium tetrachloride waste solids were regulated as solid waste in accordance with the interpretations of the State officials contacted, generators could only dispose of waste at landfills meeting the revised requirements for solid waste management that became effective on March 1, 1990. All such wastes must meet the "paint filter test" to determine that there are no free liquids in the waste. Furthermore, wastes must not display a characteristic of hazardous waste. The Ohio EPA has authorization to inspect any licensed solid waste disposal facility. Inspections are carried out in cooperation with approved local health departments. State officials noted that approved local health departments inspect industrial as well as sanitary landfills. Violations of any aspect of the solid waste regulations are considered felonies and are punishable by financial penalties of up to \$25,000 and a three year jail term per day per violation.

As of March 1, 1990 all licensed facilities must have met a variety of requirements, including ground-water monitoring, placement of a final cap at closure, financial assurance, and a closure and thirty year post-closure period (some exceptions were provided for financial assurance mechanisms). A call-in schedule has been established for facilities to obtain new permits. Within two to three years all facilities will have reported to the Ohio EPA for a revised permit.

Any site that has been in operation and closed over the last twenty years and is within 305 meters (1,000 feet) of an occupied structure, must establish an explosive gas monitoring plan and network. The new requirements include provisions for leachate collection systems and sedimentation basins for ground water; any discharge into waters of the State must be made in accordance with a NPDES permit.

Increasingly, according to State officials, landfills are subject to fugitive dust controls and require permits. Typically, however, no air monitoring is required. Air and water controls are not required for slag piles unless they are established through general provisions in the appropriate permits on a case-by-case basis. State officials noted that they have broad site-specific authority to establish controls as needed.

Any restrictions on the use of wastes, such as slag, are usually established by the water program through a monitoring plan which provides for an approved mechanism for waste management on most sites.

Officials in Ohio were able to provide a significant amount of information regarding the regulation of waste at specific ferrous facilities as well as at SCM.

The following describes the permits that Ohio State officials report ferrous metals production facilities have, and the disposal methods that the facilities reported for blast furnace APC dust and/or sludge in the National Survey of Mineral Processors:

<u>Armco</u> :	▼	Has its own permitted solid waste disposal facility on-site.
	▼	Reports that it disposes on-site.
<u>LTV</u> :	▼	One or both of the LTV facilities brings its wastes to an independent landfill, according to State officials.
	▼	Reports that it disposes on-site.
<u>US Steel</u> :	▼	Has no licensed landfill, according to State officials.
	▼	Reports stockpiling waste in a waste pile.
<u>Warren</u> :	▼	Has no licensed landfill, according to State officials.
	▼	Reports stockpiling some waste in a waste pile and returning some or all to the blast furnace.
<u>W-P Steel</u> :	▼	(Mingo Junction and Steubenville) have no licensed landfills, according to State officials.
	▼	(Mingo Junction) reports sending waste off-site for disposal. (Steubenville did not report its management of blast furnace APC dust and sludge.)

Because these facilities do not have permits for on-site landfills, under the solid waste regulations they may: 1) transport waste to a permitted landfill off-site; 2) incinerate waste; or 3) compost waste. It is extremely unlikely that ferrous metal APC dust and sludge is incinerated or composted. Thus, according to State officials' interpretation of the solid waste regulations, ferrous metals facilities should be disposing of APC dust and sludge off-site. According to the responses summarized above, however, one facility disposes waste off-site, and one facility disposes waste on-site in a permitted landfill. It is possible that a certain percentage of APC sludge is sent to wastewater treatment works (e.g., a regulated lagoon that would meet requirements established for wastewater treatment and water quality).

Ohio State officials report that the SCM facility is required to have an Ohio EPA solid waste permit for landfilling their solid waste, and an annual operating license. The SCM waste is considered a solid waste. SCM has applied for a license for a new solid waste management facility.

SCM did not have a solid waste management license in 1989. If the facility had a landfill or other solid waste management operation in 1989, it was closed, according to State officials in Ohio. Regulated alternatives for disposal of chloride solids include disposing solids in a closed-out lagoon that would be regulated by the Division of Water Pollution Control, or in a hazardous waste management unit regulated by Ohio's RCRA unit. SCM reported in its response to the National Survey of Mineral Processors that all titanium chloride process waste solids were recycled and none were disposed. This may have alleviated the need to dispose of the waste solids in the absence of a licensed waste management facility.

As outlined above, Ohio does not have specific storage requirements that would apply to ferrous APC dust and sludge or titanium process chloride waste solids. Thus, either of these wastes may escape regulation if stored for extended periods of time. For instance, as described above, a number of ferrous facilities may stockpile APC dust and sludge in waste piles indefinitely.

Pennsylvania

Seven facilities generate special wastes from mineral processing in Pennsylvania. Six of these facilities are fully integrated ferrous facilities generating iron and basic oxygen steel slag and air pollution control dust and sludge. One facility (US Steel, Fairless Hills) generates steel open hearth furnace slag and dust as well. The last facility generates

zinc slag from primary zinc production. Exhibit D-2-17 shows the names and locations of the mineral processing facilities in Pennsylvania.

The similar nature of zinc slag and ferrous wastes, as well as their joint classification in Pennsylvania as residuals waste, results in virtually identical regulation of the ferrous and zinc mineral processing wastes.

Exhibit D-2-17
Mineral Processing Facilities Located in Pennsylvania
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Allegheny Ludlum	Brackenridge	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Furnace Slag 4. Basic Oxygen Furnace APC Dust/Sludge
Bethlehem Steel	Bethlehem	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Furnace Slag 4. Basic Oxygen Furnace APC Dust/Sludge
Sharon Steel	Farrel	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Furnace Slag 4. Basic Oxygen Furnace APC Dust/Sludge
Shenango	Pittsburgh	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Furnace Slag 4. Basic Oxygen Furnace APC Dust/Sludge
US Steel	Fairless Hills	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Furnace Slag 4. Basic Oxygen Furnace APC Dust/Sludge 5. Open Hearth Furnace Slag 6. Open Hearth Furnace APC Dust/Sludge
US Steel	Braddock	Ferrous	1. Blast Furnace Slag 2. Blast Furnace APC Dust/Sludge 3. Basic Oxygen Furnace Slag 4. Basic Oxygen Furnace APC Dust/Sludge
Zinc Corporation of America	Monaca	Zinc	1. Slag

At this time, ferrous metal production wastes and zinc slag are not regulated as either hazardous or solid waste in the State of Pennsylvania, although these wastes are subject to regulation as residual waste. Pennsylvania has exempted waste from the extraction, beneficiation, and processing of ores and minerals from hazardous waste regulation. The solid waste regulations establish requirements for municipal waste which generally consists of waste from municipal, residential, commercial and institutional establishments and community activities. A proposed rule published February 24, 1990 defines residual waste as:

Garbage, refuse, other discarded material or other waste, including solid, liquid, semisolid or contained gaseous materials resulting from industrial, mining, and agricultural operations and sludge from an industrial, mining or agricultural water supply treatment facility, waste water treatment facility or air pollution control facility, if it is not hazardous (Pennsylvania Bulletin, Vol. 20, No. 8, 2/24/90).

State officials noted, as an indication that ferrous and zinc slag (and presumably ferrous APC dust and sludge) would be regulated as residual waste under the proposed rule, that the proposed rule specifically refers to a zinc slag pile ("mountain") as an example of residual waste (Pennsylvania Bulletin Vol. 20, No. 8, 2/24/90).

Presently, residual wastes are subject to regulation only at the point of disposal. A slag pile used as a disposal site must have a permit. For the most part, however, wastes that are stored (for less than one year) for later use or re-processing do not require a permit. The issue of storage leads to a conflict between industry and State officials over how long storage (particularly of iron and steel slag) should be allowed without a permit. Under the current regulations, storage in excess of one year constitutes illegal disposal. State officials and industry still disagree on the implementation of this requirement. For instance, Bethlehem Steel in Bethlehem, PA has at least one permit for disposal of residuals resulting from the production of iron and steel. The State and Bethlehem disagree, however, on exactly how the permit should be interpreted, and thus iron and steel slag is managed (or stored long term) without a permit. PADER has not required permits for the zinc slag piles at the Monaca facility.

Under the current residuals regulations (Industrial and Hazardous Waste Disposal Sites, §75.38), a permit is not required for transportation of solid waste off-site. Landfills that are permitted to receive residual waste usually must have a permit for municipal waste with an amendment to receive residuals. These landfills must use a system of double liners. Facilities must submit a permit application with a map; a leach test of the waste; and a ground-water study, including the test results of three borings (at least one up- and one down-gradient of the landfill). Phase II of the present residual rule requires landfills without liners to be above the high-water table, and to have "renovating" soil underneath. After closure the site must be re-vegetated with at least two feet of soil.

The Proposed Residual Waste Regulations, which may be finalized before the end of 1990, will establish requirements for management of residual waste, including zinc slag and ferrous wastes, similar to the Pennsylvania requirements for municipal solid waste management. State officials suggested that some industries may be granted exemptions from the rule. In particular, exemptions could be granted for materials that are re-used or re-processed. This could mean that iron and steel slag that is sold for processing, and perhaps APC dust/sludge that is re-processed, could be exempted from regulation under the final residuals rule.

The structure of the proposed regulations closely follow the Pennsylvania Solid Waste Regulations. Depending on the results of leach tests, ferrous wastes as well as zinc slag may be placed in three different types of landfills with various liner and other requirements. Generators will be required to file a form stating that they have attempted to reuse and/or recycle the waste before disposal. As with the solid waste regulations, permits will be required that include provisions for liners, leachate collection systems, monitoring wells, and disposal of leachate. The proposed rule is also similar to the municipal waste regulations with regard to prohibitions on where facilities may be located (e.g., within the 100 year floodplain, over areas of limestone). It is unclear at this time how the final regulation will address inactive or abandoned sites, although the proposed rule indicates that facilities without permits must document closure procedures within a certain time frame.

Water regulation of ferrous metal production wastes and zinc slag in Pennsylvania is primarily determined on a case-by-case basis. Although the State has authority to regulate discharge from slag waste piles, State personnel indicated that discharge limits would most likely be established only if there was evidence of contamination. If facilities channel run-off to lagoons or storm water discharge basins, the effluent would be sampled and the facility would be required to meet certain contaminant limits. State drinking water standards could also be invoked. Legally, facilities are not required to report on the storage of waste. Thus, particularly in the case of iron and steel slag that is stored speculatively, the State might not have the authority to require controls for a slag pile that is considered a storage pile for an indefinite period. Run-off from unlined zinc or ferrous slag piles or ferrous APC dust and sludge piles could be very difficult to collect. Thus, contaminated run-off may not be subject to any State controls.

Air regulations in Pennsylvania apparently apply mainly to processes that generate air emissions. The department does not regulate air emissions from waste disposal and management activities. According to one State official, if a complaint was received regarding fugitive dust emissions from a mineral processing type facility, the inquiry would be referred to the waste management division.

Tennessee

There are three mineral processing facilities in Tennessee that are under study for this report: two elemental phosphorus processing facilities that generate slag and one titanium tetrachloride facility that generates chloride process waste solids. The facilities, their locations, and the waste streams they generate are presented in Exhibit D-2-18.

Exhibit D-2-18 Mineral Processing Facilities Located in Tennessee and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
duPont	New Johnsonville	Titanium Tetrachloride	1. Chloride Process Waste Solids
Rhone-Pulenc	Mt. Pleasant	Elemental Phosphorus	1. Furnace Slag
Occidental	Columbia	Elemental Phosphorus	1. Furnace Slag

The Tennessee Hazardous Waste Management Regulations exempt wastes from the extraction, beneficiation, and processing of ores and minerals from regulation as hazardous waste. Therefore, neither chloride process waste solids nor elemental phosphorus slag are regulated as hazardous waste in Tennessee.

The Tennessee Solid Waste Regulations include industrial waste in its definition of solid waste; however, prior to 1981, if the industrial waste was disposed on-site, then it was not regulated at all under the solid waste regulations provisions. In 1981 new regulations were enacted that developed classes and design and operating standards for on-site and off-site solid waste landfills. These regulations focused almost exclusively on municipal solid waste (Class I landfills) and, although industrial waste landfills were designated and regulated as Class II landfills, enforcement of the standards was not vigorous. Another new set of regulations, however, came into effect in March 1990. These regulations require various management practices for both Class I and Class II landfills, including approval of design drawings, contouring plans, liners, leachate collection systems or other vertical buffers, and conditional ground-water monitoring. Any new solid waste disposal facility must meet these requirements, while existing facilities are granted a four year grace period to comply. The regulations also include requirements for financial assurance for closure and 30 years of post-closure care. The State can and does conduct on-site inspections and enforcement actions. Most of the resources are still focused on municipal solid waste, and it will take time to bring all the old landfills into compliance with the new regulations.

The Tennessee Water Quality Control Act requires a permit for various activities, including the development of any natural resource. The State has an approved NPDES program, and both the Occidental Chemical facility in Columbia and the Rhone-Pulenc facility in Mt. Pleasant have obtained an NPDES permit for discharges from their elemental phosphorus processing activities. The effluent restrictions are based on the Federal effluent guidelines and on the level of treatment necessary to protect the receiving waters. The permits include requirements for bio-monitoring and allude to the necessity of compliance with solid waste management requirements in the Tennessee Solid Waste Disposal Act and the Tennessee Hazardous Waste Management Act. The Occidental facility has a permit for an onsite industrial landfill which receives any non-hazardous process wastes. The Rhone-Pulenc facility had an on-site permit, reached a point where they reprocessed some of the material in the waste pile, and then finally removed all waste from the site. It is the current practice of both facilities to attempt to sell all the furnace slag that is generated to a reuser. The quantity that is not sold is stockpiled on-site or landfilled at a permitted municipal landfill.

The titanium tetrachloride facility in Tennessee that is under study for this report is the duPont facility in New Johnsonville, TN. It currently produces chloride process waste solids which are treated and landfilled. The duPont facility has received solid waste landfill permits in 1977, 1978, 1981, 1986, and 1987 for a number of landfills which the

facility utilizes to dispose of different types of waste generated on-site. The facility also has a NPDES permit to discharge from the on-site surface impoundment used to treat process wastes. This permit includes requirements for effluent monitoring, bio-monitoring, and for compliance with State solid and hazardous waste management regulations in the management of any sludge or solid material generated in the wastewater treatment process.

Texas

Texas has one phosphoric acid facility, two hydrofluoric acid facilities, one chrome facility, one alumina facility, and three copper facilities, as outlined in Exhibit D-2-19.

Exhibit D-2-19
Mineral Processing Facilities Located in Texas
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Alcoa	Point Comfort	Bauxite	1. Red and Brown Muds
Reynolds	Gregory	Bauxite	1. Red and Brown Muds
American Chrome	Corpus Christi	Chromite	1. Roast/Leach Ore
ASARCO	Amarillo	Copper	1. Slag
ASARCO	El Paso	Copper	1. Slag
Phelps Dodge	El Paso	Copper	1. Slag
duPont	LaPorte	Hydrofluoric Acid	1. Process Wastewater 2. Fluorogypsum
Mobil Mining	Pasadena	Phosphoric Acid	1. Process Wastewater 2. Phosphogypsum

Texas administers an authorized Subtitle C program. According to State officials, the Texas Hazardous wastes program closely models RCRA, incorporating the Federal exclusion for mineral processing wastes.

The Texas Industrial Waste Management Regulations establish standards for all aspects of the management and control of municipal hazardous waste and industrial solid waste. According to State officials, the mineral processing facilities in this State discussed in this report are subject to only one express requirement, the notification stipulation (TAC, Title 31, §335(a),(f),(g)) of the regulations, in order to dispose of their respective special wastes. Owners or operators were and are required to notify the Texas Water Commission 90 days prior to the onset of disposal activities and may be required to submit any of the following information: waste composition, waste management methods, facility engineering plans, and the geology where the facility is located. Ninety-day advance notice for expansion or closure is also required. The owner or operator is required to submit details of closure activities if requested by the Texas Water Commission. The TWC can initiate enforcement activity against a firm if the closure activities are deemed inadequate. Under the General Prohibitions (§335.4), owners and operators are not allowed to discharge industrial solid waste into the waters of the State without specific authorization from the TWC.

According to State officials, of the three Texas copper facilities, only Asarco's El Paso facility is subject to the requirements of these regulations. The Asarco facility in Amarillo and Phelps Dodge's facility in El Paso reuse their copper slag and are not subject to these regulations.

No solid waste disposal permit is required at the facilities for disposing phosphogypsum and process wastewater from phosphoric acid production; fluorogypsum and process wastewater from hydrofluoric acid production;

red muds from alumina production; treated roast/leach ore residue from sodium dichromite production; and slag, calcium sulfate sludge, and slag tailings from primary copper processing because these wastes are disposed on properties that are: (1) located within 50 miles of the facilities where they are generated; and (2) owned or controlled by the owner/operator of the facilities. These facilities do have "registrations", which are essentially inventories of the wastes generated and the manner in which they are managed.

According to a State official, the regulations do not outline specific requirements for waste piles or surface impoundments that manage industrial solid waste. Owners or operators are not expressly required to place liners under the impoundments or to monitor ground-water. No closure and post-closure care requirements exist for industrial solid waste piles or impoundments. These facilities are not required to maintain a surety bond for financial assurance. The Texas Water Commission does provide ten Technical Guidelines to advise owners/operators on appropriate liner materials and thickness, closure and post-closure care activities, and site selection criteria, among other things. According to a State official, these Guidelines merely advise and recommend; they do not outline requirements.

Texas does not have an EPA-approved NPDES program. The Texas Water Quality Acts state that no person may discharge "industrial waste into or adjacent to any water of the State" without a permit. As a result, Texas has a "dual permitting system" in which both a Federal NPDES and a State Wastewater Discharge Permit are required for wastewater discharges to surface waters. The Mobil phosphoric acid facility and the duPont hydrofluoric acid facility have both. According to a State official, Reynolds does not have a NPDES permit and does not discharge to surface water. State permit requirements are outlined in the Texas Wastewater Treatment Regulations. The regulations set specific discharge limits and stipulate that process water must be retained in a surface impoundment capable of retaining maximum process flow without allowing any discharge of pollutants. If discharge of these waters can be prevented by retention, a permit is not required. According to a State official, a State discharge permit may address discharge of process wastewater and discharge of contaminated or non-contaminated storm water ponds.

According to a State official, of the three copper facilities in this State addressed by this report, the Asarco facility in El Paso is the only one that is subject to the Texas Water Quality Acts (Title 2, Chapter 26 of the Texas Administrative Code) and the Water Quality Standards for its slag disposal activities. The facility must ensure there will be no contamination of ground water or surface water from slag disposal activities. Run-off controls may be required in order to ensure compliance with this requirement. The water quality standards set site-specific limits to ensure no degradation of water bodies. According to a State official, the Asarco plant is under an enforcement order as a result of run-off from slag piles into the Rio Grande River. High levels of arsenic were found. Asarco has since built an impoundment to collect storm water run-off.

The Texas Clean Air Act generally prohibits any emission without a permit, which is issued by the Texas Air Control Board. In general, these permits for these facilities mainly address emissions from the respective production processes, and waste disposal units are subject only to general requirements within the permit. According to State officials, no requirements of the Act apply to the copper slag generated at Amarillo or the Phelps-Dodge/El Paso facilities because any slag produced is reused and not disposed. According to a State official, copper slag produced and disposed at the Asarco facility in El Paso also is not subject to air requirements, such as water spraying and chemical sealing for control of fugitive dust from slag piles, because the material hardens as it cools. Historically, fugitive dust has not posed a problem.

The Alcoa and Reynolds facilities have permits from the Texas Air Control Board. According to a State official, the permit mainly addresses emissions from the production process and, therefore, the surface impoundments at these facilities are subject only to general requirements within the permit. The State official mentioned that at both facilities, the surface impoundments used for the disposal of the muds have needed modifications. In both instances, the impoundments were drying up, causing fugitive dust emissions problems. At Reynolds, there was an enforcement action for violation of a permit requirement, and the Air Pollution Board has had complaints about the Alcoa/Point Comfort plant. Reynolds now uses a flooding process to keep the muds completely under water, employing water from the nearby (saltwater) bay. Alcoa puts a coarse river sand over areas that become dry in order to control emissions.

According to the State official, the Texas Clean Air Act is the main piece of legislative authority for the Texas Air Pollution Board. Air Regulation No. 6 requires that a permit be obtained for construction or modification of a facility

that would emit air contaminants. According to the State official, by requiring a permit to modify a facility, this regulation picks up the "grandfathered" facilities that were constructed prior to the cutoff date for "new" facilities. The permit system requires the use of Best Available Control Technology.

Utah

There are three mineral processing facilities in Utah that are under study for this report: a magnesium facility that generates process waste water, a copper processing facility that generates slag, slag tailings and calcium sulfate sludge, and a ferrous metals facility that generates iron blast furnace and steel open-hearth furnace slag and APC dust and sludge. The facilities, their locations, and the waste streams they generate are presented in Exhibit D-2-20.

Exhibit D-2-20
Mineral Processing Facilities Located in Utah
and the Waste Streams They Generate

Facility	Location	Sector	Waste Streams
Nagcorp	Rowley	Magnesium	1. Process Wastewater
Kennecott	Garfield	Copper	1. Slag 2. Slag Tailings 3. Calcium Sulfate Sludge
Geneva	Orem	Ferrous	1. Open-hearth Slag 2. Open-hearth APC Dust/Sludge 3. Iron Blast Furnace Slag 4. Iron Blast Furnace APC Dust/Sludge

According to State officials, the language of the Utah Solid and Hazardous Waste Act was developed in an attempt to provide a flexible scope with respect to both solid and hazardous waste regulation. The Utah Hazardous Waste Regulations exempt wastes from the extraction, beneficiation and processing of ores and minerals from regulation as hazardous waste and Section 26-14-6 of the Solid and Hazardous Waste Act exempts those wastes from the scope of rulemaking as solid wastes. As a result, none of the special wastes from primary copper processing, magnesium processing or ferrous mineral processing are specifically addressed by the State solid or hazardous waste regulations.

Section 26-14-6, however, also provides for the regulation of extraction, beneficiation, and processing wastes as hazardous wastes under certain conditions. More specifically, if a waste is either listed by EPA as hazardous waste or is determined to be hazardous through the evaluation of the waste against hazardous waste criteria, it will fall under the State's hazardous waste regulatory program. Once EPA makes a determination on the status of the currently exempt special mineral processing wastes, those wastes will be addressed by the State's regulatory program in accordance with that decision, i.e., Utah's position with respect to the 20 special mineral processing wastes will parallel that of EPA.

The State has an approved NPDES program and the State Water Pollution Control Committee is empowered by the Utah Water Pollution Control Act to promulgate water quality standards, classify State waters, promulgate and enforce effluent limitations, and issue discharge permits. The State can and does conduct on-site inspections, as well as enforcement actions if the facility is found to be in violation of a permit. As of January 1990, new ground-water protection legislation was enacted and the new ground-water office is in the process of designing ground-water discharge permits. No such permits have been issued as yet.

The tailings impoundment that is used for disposal of slag tailings at the one primary copper processing facility in Utah also receives tailings from ore beneficiation, run-off, and discharges from all of the facility's various operations. Discharge from the impoundment to a Class VI surface water is controlled under the conditions of a NPDES permit. The

designated use for a Class VI water in Utah is defined as "special," and waters with this classification are generally not suitable for any of the other beneficial uses designated by the State. Discharge standards for Class VI receiving waters are determined on a case-by-case basis. The State is in the process of negotiating a new NPDES permit that will include bio-monitoring provisions in addition to existing BMP requirements. EPA Region VIII is taking a special interest in the terms of this permit because of the designation of the receiving waters, under the Clean Water Act, as a special impaired area.

The Utah Air Conservation Regulations specifically regulate sulfur dioxide air emissions and visible compounds from the primary copper processing operations at the Kennecott facility. Fugitive dust emissions from tailings piles and ponds at the facility are not specifically regulated but are covered by the general fugitive dust control requirements for tailings ponds and piles in Utah. Management practices that may be required for dust control include watering and/or chemical stabilization, synthetic or vegetative covers, wind breaks, and restrictions on the speed of vehicles in and around tailings operations.

Under the provisions of Title 26, Chapter 11 of the Act, a Utah Pollutant Discharge Elimination System Permit has been issued to the Magcorp magnesium facility that requires the facility to have no discharge to surface waters. The permit also requires the facility to monitor pH on a quarterly basis in a test well adjacent to the impoundment and in standing water between the impoundment dikes and the Great Salt Lake. Monitoring results that indicate pH values outside of the range of 6.5 to 9.0 must be reported to the State and EPA within seven days. Based on review of the monitoring data, Magcorp may be required to develop and implement a plan to eliminate seepage from the impoundment. Any plans developed require approval prior to implementation.

The ferrous metal facility in Utah under study for this report is the Geneva facility in Orem, Utah. It generates iron blast furnace slag and APC dust and sludge and steel open-hearth furnace slag and APC dust and sludge. The facility recycles its slag by selling it to a recycler that is located on or near the Geneva facility itself. According to State officials, none of these wastes are regulated under the State's solid waste authority, and the only permits that exist for the facility are air and water quality permits. The facility is currently involved in negotiating a new NPDES permit with EPA and has just reached a tentative settlement agreement with EPA in response to a permit violation. According to the State official, the new permit will include new bio-monitoring requirements and more stringent ammonia effluent limitations. The permitted discharge is from a retention basin that collects all run-off from the site. Although State air quality regulations require general fugitive dust control measures, there was no confirmation by State officials that those measures were in place at the Geneva facility.

Appendix E-1

**RCRA Subtitle C Statutory and
Regulatory Provisions**

Appendix E-1

RCRA Subtitle C Statutory and Regulatory Provisions

1. Definition of a RCRA Hazardous Waste CFR § 261.3:

- 1) The waste is or contains a hazardous waste listed in Subpart D of Part 261; or
- 2) The waste exhibits any of the characteristics in Subpart C of Part 261: ignitability, corrosivity, reactivity, or EP toxicity.
 - a) May be **exempted under 261.4(b)** - solid wastes that are not hazardous wastes include:
 - mining overburden returned to mine site;
 - fly ash waste, bottom ash waste, and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels;
 - solid wastes from the extraction, beneficiation and processing of ores and minerals (including coal), including phosphate rock and overburden from the mining of uranium ore; and
 - wastes that fail the test for the characteristic of EP toxicity because chromium is present or are listed in Subpart D because chromium is present, wastes that do not fail the test for the characteristic of EP toxicity for any other constituent or are not listed due to the presence of any other constituent, and wastes that do not fail the test for any other characteristic if shown by a generator that:
 - the chromium in the waste is exclusively or nearly exclusively trivalent chromium;
 - the waste is generated from an industrial process that uses trivalent chromium exclusively or nearly exclusively and the process does not generate hexavalent chromium; and
 - the waste is typically and frequently managed in non-oxidizing environments.
 - b) May be **exempted under § 260.22** - Petition to amend Part 261 to exclude a waste from a particular facility. A person seeking to exclude a particular waste from the list of wastes in Subpart D must show that the waste does not exhibit any of the criteria under which the waste was listed as hazardous. The Administrator can look at constituents in the waste other than those that the waste was listed for. Even though the waste may be de-listed, it may still exhibit hazardous characteristics and, thus, be regulated under Subpart C.

2. Hazardous Waste Regulations Generally

- If generated by a conditionally exempt small quantity generator (SQG), waste is subject to provisions under § 261.5. A conditionally exempt SQG is a generator that generates 100 kilograms or less of hazardous waste a month.
- If intended to be legitimately and beneficially used, re-used, recycled, or reclaimed and is a sludge or is a listed hazardous waste (Part 261, Subpart D) or is a mixture containing a listed waste, it is subject to the following regulations with respect to transportation and storage:
 - Notification under RCRA § 3010. All persons generating, transporting, treating, storing, or disposing hazardous waste must notify EPA.

- Parts 262 and 263. Part 262 concerns requirements for generators of hazardous waste. Part 263 concerns standards applicable to transporters of hazardous waste.
- Part 264, Subparts A through E. Part 264 sets forth standards that apply to owners and operators of treatment, storage, and disposal facilities.
- Part 265, Subparts A through E, G through J, and L. Sets forth requirements that apply to facilities that have not received a permit.
- Parts 270 and 124. Parts 270 and 124 set forth permit requirements.
- If not intended to be legitimately and beneficially used, re-used, recycled, or reclaimed then is intended to be discarded and subject to subtitle C regulations:
 - Part 262 - Generators
 - Part 263 - Transporters
 - Parts 264 and 262.34 - Owners/operators of TSD facilities - on-site generators storing waste less than 90 days for subsequent shipment off-site.
 - Part 265 - Owners/operators of TSD facilities who qualify for interim status must apply for a permit.
 - Part 270 - Owners/operators of TSD facilities who do not qualify for interim status must apply for a permit.

3. Permit Requirements

- A RCRA permit must be obtained by persons who treat, store, or dispose of wastes that:
 - 1) have been removed from the Mining Waste Exclusion, and
 - 2) are characteristically hazardous or are listed hazardous wastes.

Notification

Persons who treat, store, or dispose of hazardous waste must file a notification with the Administrator within 90 days of the final rule that removed the wastes from the Bevill exemption (by April 23, 1990). The notification must state the location and description of the facility and the identified hazardous wastes handled.

- If the person is in a State that has an authorized hazardous waste permitting program, notification will be required after the State receives authorization or amends its program to regulate these wastes.

Permit Application Made in Two Parts

- a) Part A Permit Application
 - Timely submission of notification and a Part A application qualifies an existing facility for interim status. The requirements for interim status facilities are described in section 4 below.

b) Part B Permit Application

- The Regional Administrator or the State Director will request a Part B application; facilities will be notified 6 months before the Part B application is due. Owners and operators of land disposal facilities must submit Part B applications within 12 months of the effective date of the regulations. The requirements for fully permitted facilities are set out in sections 5 through 15 below.

4. Interim Status

Applicability

- The Federal standards for interim status facilities apply to owners and operators (O/Os) of existing treatment, storage, and disposal facilities:
 - who have fully complied with the notification requirements and the Part A permit application requirements until either a permit is issued or until closure and post-closure responsibilities have been met; or
 - who have failed to obtain interim status.
- The standards do not apply to:
 - persons disposing of hazardous waste by means of ocean disposal under a permit issued under the Marine Protection, Research, and Sanctuaries Act;
 - O/Os of a POTW that treats, stores, and disposes of hazardous waste;
 - persons who treat, store, and dispose of waste regulated by a RCRA authorized State;
 - O/Os of a facility managing recyclable materials (**261.6 (a)(2) and (3)**) (see list in Part 264 standards, section 5 below);
 - a generator accumulating hazardous waste on-site for less than 90 days;
 - O/Os of a totally enclosed treatment facility;
 - O/Os of an elementary neutralization unit or a wastewater treatment unit (see definition in Part 264 standards, section 5 below);
 - a person engaged in treatment or containment activities during immediate response to a discharge; and
 - a transporter storing materials in containers meeting applicable requirements.

Permit Application Requirements for Existing Facilities

- **270.10(e)** - O/Os of existing facilities must submit a Part A permit application. Facilities that submit notification and Part A of the application are qualified for interim status.
- Part A applications must be submitted within 6 months of the final rule that removed the wastes from the Bevill exemption (by July 23, 1990).

Operating Requirements

- Requirements for interim status facilities are the same as for fully permitted facilities under Part 264 (see section 5) except in the following instances:
- For tank systems, O/Os must conduct a waste analysis whenever the waste treated in the tank is substantially different from the waste that was treated in the tank before. O/Os must perform trial treatment or show that existing treatment meets applicable requirements;
- For surface impoundments, O/Os must conduct a waste analysis whenever the waste treated in the surface impoundment is substantially different than was treated before or is being treated by a different process. O/Os must perform trial tests;
- For waste piles, O/Os must analyze a representative sample of incoming waste unless the wastes are compatible with wastes already being treated; and
- For land treatment, O/Os must:
 - determine the concentrations of substances that exceed the maximum concentrations contained in Table 1 of Part 261 that cause a waste to exhibit the EP toxicity characteristic;
 - if the waste is a listed hazardous waste, determine the concentrations of substances that caused the waste to be listed; and
 - if food chain crops are grown, determine the concentrations of arsenic, cadmium, lead, and mercury, unless the O/O can show that the constituents are not present.

5. Fully Permitted Facilities

Applicability

- Part 264 standards apply to all O/Os of facilities that treat, store, or dispose of hazardous waste except as specifically provided.
- Standards apply to persons who dispose of hazardous waste through ocean disposal subject to a permit under the Marine Protection, Research, and Sanctuaries Act only to the extent that they are included in a RCRA permit by rule.
- Standards apply to persons disposing of waste by underground injection subject to a permit issued under the Underground Injection Control program approved or promulgated under the Safe Drinking Water Act only to the extent that they are required by §144.14 of this chapter. (The Part 264 requirements do not apply to above-ground treatment or storage of hazardous waste before it is injected underground.)
- Standards **do not** apply to:
 - persons who treat, store, or dispose of wastes regulated by a State with a State authorized RCRA hazardous waste program;
 - O/Os of a facility permitted or licensed by a State to manage municipal or industrial solid waste if the only hazardous waste generated is exempted under the small quantity generator provision;
 - O/Os of a facility managing recyclable materials (**261.6 (a)(2) and (3)**); Recyclable materials include the following:

- recyclable materials used in a manner constituting disposal;
- recyclable materials from which precious metals are reclaimed;
- scrap metal; and
- coke and coal tar from the iron and steel industry that contains EPA hazardous waste K087.
- a generator accumulating hazardous waste for less than 90 days;
- O/Os of a totally enclosed treatment facility;
- O/Os of an elementary neutralization unit (a tank, tank system, container, transport vehicle, or vessel that is used for neutralizing wastes that are hazardous only because they exhibit the corrosivity characteristic or they are listed in Part 261, Subpart D only because they exhibit the corrosivity characteristic) or is a wastewater treatment unit (a tank or tank system device that is part of a wastewater treatment facility subject to regulation under the Clean Water Act and receives, treats, or stores an influent hazardous wastewater; generates and accumulates a wastewater treatment sludge that is a hazardous waste; or treats or stores a wastewater treatment sludge that is a hazardous waste);
- a person engaged in treatment or containment activities during immediate response to a discharge; and
- a transporter storing materials in containers meeting applicable requirements.
- All O/Os that treat, store, or dispose of hazardous waste at a surface impoundment or a landfill that submit a Part B permit application after August 8, 1985, must provide information on the potential for the public to be exposed to hazardous waste/constituents through release from the facility.
- O/Os who have already submitted a Part B application must submit exposure information by August 8, 1985.

General Information Requirements for Part B Applications

- The following information is required for all hazardous waste management facilities:
 - **264.13(a)(1)** - Before an O/O treats, stores, or disposes of a waste he must obtain a detailed chemical and physical analysis of a sample of the waste. Analysis must contain all information necessary to treat, store, or dispose of the waste.
 - **264.13(a)(3)** - The analysis must be repeated as necessary to assure it is accurate and up to date.
 - **264.13(b)** - O/Os must develop a written waste analysis plan. The plan must contain: the parameters for each hazardous waste to be analyzed and a rationale for choosing the parameters; test methods used to test for the parameters; sampling methods used; the frequency of the review and repetition of the initial waste analysis; for off-site facilities, the analysis that the generators supply; any additional analysis required for ignitable, reactive, or incompatible wastes, bulk or containerized liquids, or wastes subject to the land disposal restrictions; and procedures and schedules for surface impoundments exempted from land disposal restrictions.
 - **264.14(a)** - the O/O must secure his facility to prevent unauthorized entry unless he can demonstrate physical contact with any of the equipment, waste, etc. will not cause injury and will not cause a violation of this subsection.
 - **264.14(b)** - If the O/O is required to have security pursuant to § 264.14(a) above, he must have:
 - a 24-hour surveillance system or a barrier that will keep people out; and

- a means to control entry at all times.
- **264.15(a)** - O/Os must inspect the facility for malfunctions and deteriorations, operator error, and discharges. Inspection must be often enough to correct any problems before they harm human health or the environment.
- **264.18(a)** - New facilities can not be located within 61 meters (200 feet) of a fault that has had movement of any two sides in Holocene time ("holocene" means the most recent epoch of the Quaternary period, extending from the end of the Pleistocene to the present).
- **264.18(b)** - A facility located in a 100-year floodplain must be designed to prevent washout of any hazardous waste by a 100-year flood. The O/O can avoid the design requirements if he can demonstrate to the Administrator that: 1) the facility has procedures that will remove hazardous wastes to a location where the wastes will not be touched by flood waters; or 2) for existing surface impoundments, waste piles, land treatment units, landfills, and miscellaneous units, no adverse effects on human health or the environment will result if washout occurs. Several factors must be considered, such as the volume and chemical characteristics of waste in the facility, the concentration of the hazardous constituents that may affect surface water, the impact of the constituents on users of the water and on water quality standards, and the impact of the constituents on soil.
- **264.18(c)** - No non-containerized or bulk liquid hazardous waste can be placed in any salt dome formation, salt bed formation, underground mine or cave, with the exception of the Department of Energy Waste Isolation Pilot Project in New Mexico.
- **264.112** - O/Os of hazardous waste management facilities must have a written closure plan. The closure plan must:
 - describe how each management facility will be closed;
 - give an estimate of the types of wastes at the facility; the methods for removing, transporting, treating, storing, or disposing wastes; and an identification of the off-site facilities to which the wastes will go;
 - describe steps to remove and decontaminate all hazardous waste residues, equipment, containment system components, and soils;
 - describe all ground-water monitoring, leachate collection, and run-on and run-off control; and
 - include a schedule for closure.
- **264.118** - A copy of the post-closure plan. The plan required for hazardous waste management facilities must include:
 - a description of the monitoring and maintenance activities that will be performed to ensure the integrity of the cap and final cover or other containment system, and the functioning of the remaining monitoring equipment.
- **264.178** - At closure, all hazardous waste and hazardous waste residue must be removed from all containment systems. Remaining containers, liners, bases, and soil containing hazardous constituents must be decontaminated or removed.
- **264.197** - Closure and post-closure care requirements for tank systems: remove or decontaminate all waste residues, equipment, and tanks. If the O/O can demonstrate that it is not practicable to remove or decontaminate all contaminated soils, the O/O must close and perform post-closure care in accordance with the requirements that apply to a landfill (see §264.310 below).

- **264.228** - Closure and post-closure care requirements for surface impoundments. The O/O must:
 - a) remove or decontaminate all waste residues, contaminated containers, soils, and equipment; or
 - b) eliminate free liquids; stabilize remaining wastes to a capacity to support final cover; and cover the surface impoundment with a final cover that will minimize long-term liquids migration, require minimal maintenance, promote drainage and minimize erosion of the cover, accommodate settling or subsidence so that the cover's integrity is maintained, and have a permeability less than or equal to the permeability of any bottom liner system or natural soils present.
- **264.258** - Closure and post-closure care for waste piles. O/Os must:
 - remove or decontaminate all waste residues, contaminated containers, soils, and equipment;
 - if there are hazardous constituents that can not be practicably removed or treated, the O/O must close the facility as if it were a landfill (see § 264.310 below); and
 - if a waste pile that does not have a liner designed to minimize migration of wastes, the O/O must prepare a contingent closure plan in case not all of the hazardous constituents can be removed.
- **264.280** - Closure and post-closure care for land treatment facilities. O/Os must:
 - continue operations that degrade, transform, or immobilize hazardous waste constituents within the treatment zone;
 - continue operations to minimize run-off of hazardous constituents;
 - maintain run-on control system;
 - maintain run-off management system;
 - control wind dispersal of hazardous constituents;
 - continue unsaturated zone monitoring; and
 - plant vegetative cover on the area being closed.
- **264.310** - Closure and post-closure care requirements for landfills. O/Os must cover the landfill with a cover that:
 - provides long-term minimization of liquid migration through the closed landfill;
 - requires little maintenance;
 - accommodates settling and subsidence so that the cover's integrity is maintained; and
 - has a permeability of less than or equal to the permeability of any bottom liner system or natural subsoils present.

- During the post-closure care period the O/O must:
 - maintain the final cover;
 - continue leachate collection and removal;
 - maintain ground-water monitoring; and
 - prevent run-on and run-off from eroding or damaging the final cover.
- **264.142** - O/Os must have a detailed written estimate, in current dollars, of the cost of closing the facility.
- **264.143** - All O/Os, except those exempted under §264.1, must establish financial assurance for closure for each facility.
- **264.144** - O/Os of a disposal surface impoundment, disposal miscellaneous unit, land treatment unit, landfill unit, or a surface impoundment or waste pile required to prepare a contingent closure and post-closure plan, must have a detailed written estimate of the annual cost of closure and post-closure care.
- **264.145** - All O/Os that must submit a contingent closure and post-closure plan must establish financial assurance for the post-closure care.
- **264.147(a)** - O/Os of a TSD facility, or a group of facilities, must demonstrate financial responsibility for bodily injury and property damage to third parties caused by sudden accidental occurrences arising from the operation of the facility in the amount of at least \$1 million per occurrence with an annual aggregate of at least \$2 million.
- **264.147(b)** - O/Os of a surface impoundment, landfill, or land treatment facility that is used to manage hazardous waste, or a group of facilities, must demonstrate financial responsibility for bodily injury and property damage to third parties caused by non-sudden accidental occurrences arising from the operation of the facility in the amount of at least \$3 million per occurrence with an annual aggregate of at least \$6 million. O/Os may combine the per-occurrence coverage levels for sudden and non-sudden occurrences into a single per-occurrence level, and may combine the annual aggregate coverage levels for sudden and non-sudden occurrences into a single annual aggregate level.
- **270.14(b)(19)** - O/Os must prepare a topographic map showing the distance of 1000 feet around the facility at a scale of 2.5 centimeters (1 inch) equal to not more than 61.0 meters (200 feet).
- **270.14(c)** - Additional ground-water protection information. O/Os must:
 - provide a summary of the ground-water monitoring data obtained during the interim status period;
 - identify the uppermost aquifer and aquifers hydraulically interconnected beneath the facility property. Must include ground-water flow direction and rate, and the basis for this information;
 - provide, on the topographic map required under § 270.14(b)(19), a delineation of the waste management area, the property boundary, the proposed point of compliance, the proposed location of the ground-water monitoring wells, and the aquifer information required under § 270.14(c)(2);
 - provide a description of any plume of contamination that has entered ground water; and
 - prepare plans and engineering reports of the proposed ground-water monitoring system and detection monitoring program.

- if hazardous constituents have not been detected in the ground water at the time of permit application, the O/O must submit information, data, and analyses to establish a detection monitoring system.
- if hazardous constituents have been detected in the ground water at the point of compliance, the O/O must submit information, data, and analyses to establish a compliance monitoring system.
- if hazardous constituents have been measured in the ground water that exceed the maximum concentration limits, or if ground-water monitoring at the waste boundary indicates that hazardous constituents from the facility are present over background levels, the O/O must submit information, data, and analyses to establish a corrective action program.

6. SUBPART C - Specific Requirements for Preparedness and Prevention

- **264.31** - Facilities must be designed to minimize fire, explosion, or release of wastes.
- **264.32** - Facilities must be equipped with:
 - an internal communications or alarm system;
 - a device to summon emergency assistance;
 - portable fire extinguishers; and
 - water to supply hoses or an automatic sprinkler system.
- **264.33** - All equipment listed above must be maintained and tested.

7. SUBPART F - Particular Standards for Releases From Solid Waste Management Units

- **264.90(b)** - An O/O's regulated units are not subject to the requirements under this section if:
 - exempt under 264.1; or
 - the Regional Administrator finds that he operates a unit that:
 - is an engineered structure that does not receive or contain liquid waste or waste containing free liquid;
 - is designed and operated to exclude liquid, precipitation, and other run-on and run-off;
 - has both inner and outer layers of containment enclosing the waste;
 - has a leak detection system built into each containment layer;
 - the leak detection system will be continually operated and maintained during the active life of the facility and during closure and post-closure care; and
 - the system will not, to a reasonable degree of certainty, allow hazardous constituents to migrate beyond the outer containment area.
- the Regional Administrator finds that the treatment zone of a land treatment unit does not contain levels of hazardous constituents that are above background levels by an amount that is statistically significant, and if an unsaturated zone monitoring program (see § 264.278) has not shown a statistically significant increase in hazardous constituents below the treatment zone during the operating life of the unit. An

- exemption under this paragraph can only exempt an O/O from the requirements of this Subpart during the post-closure care period;
- the Regional Administrator determines that there is no potential for migration of liquid to the uppermost aquifer during the active life of the regulated unit including the closure period and during the post-closure care period. A certified geologist or geotechnical engineer must certify this; or
- the O/O operates a waste pile that is inside or under a protective cover that provides protection from precipitation.
- **264.91(a)** - O/Os must conduct a monitoring and response program (the Regional Administrator specifies the elements of each applicable program in the facility permit) as follows:
 - whenever a hazardous constituent is detected at a statistically significant level at a compliance point the O/O must institute a compliance monitoring system pursuant to § 264.99;
 - whenever the ground-water standard is exceeded by a statistically significant amount the O/O must complete a corrective action program pursuant to § 264.100;
 - whenever hazardous constituents from a regulated unit exceed the concentration limits between the compliance point and the downgradient facility property the O/O must complete a corrective action program; and
 - in all other cases, O/Os must institute a detection monitoring program that monitors waste constituents pursuant to § 264.98.

All ground-water monitoring systems must comply with the requirements in § 264.97 including:

- **264.97(a)** - A ground-water monitoring system must have a sufficient number of wells at appropriate locations and depths to yield samples from the uppermost aquifer that represent:
1) the quality of background water that has not been affected by leakage from a regulated unit; and
2) the quality of ground water passing the point of compliance.
- **264.97(b)** - If a facility contains more than one regulated unit, separate ground-water monitoring systems are not needed for each unit so long as the systems ensure detection and measurement at the compliance point of hazardous constituents from the regulated units.
- **264.97(c)** - All monitoring wells must be cased so as to maintain the integrity of the monitoring bore hole.

Sections 264.98, 264.99, and 264.100 impose specific requirements for detection monitoring, compliance monitoring, and corrective action monitoring systems in addition to the general requirements specified in § 264.97. These requirements include:

- **264.98(c)** - O/Os must establish and maintain an approved ground-water monitoring detection system for each chemical parameter and each chemical constituent specified in the facility permit.
- **264.99(a)-(e)** - O/Os who are required to establish a compliance monitoring program must:
monitor the ground water to determine whether the regulated units are in compliance with the ground-water protection standard specified in § 264.92; install a ground-water monitoring system at the compliance point; determine whether there is statistically significant evidence of increased contamination for any chemical parameter or hazardous constituent specified in the permit; and at least annually, determine the ground-water flow rate and direction of the uppermost aquifer.
- **264.100(a)** - O/Os must take corrective action to ensure that regulated units are in compliance with the ground-water protection standard in the facility permit.

- **264.100(b)** - O/Os must institute an approved corrective action program that prevents hazardous constituents from exceeding their concentration limits by removing the hazardous waste constituents or treating them in place.
- **264.100(d)** - O/Os must implement an approved ground-water monitoring program to demonstrate the effectiveness of the corrective action program.
- **264.101(a)** - O/Os seeking a permit for a TSD facility must institute an approved corrective action program as necessary to protect human health and the environment for all releases of hazardous waste or constituents from any solid waste management unit.

8. SUBPART G - Closure and Post-Closure

- **264.111(a) - (c)** - O/Os must close the facility in a manner that: 1) minimizes the need for further maintenance; 2) controls and minimizes post-closure escape of hazardous waste, run-off, or hazardous waste decomposition products to ground and surface water and to the atmosphere; and 3) complies with all closure requirements.
- **264.114** - All contaminated equipment and soils from partial and final closure must be properly disposed of or decontaminated.
- **264.117** - Post-closure care must begin after completion of closure and must continue for 30 years.

9. SUBPART I - Specific Requirements for Use and Management of Containers

- **264.172** - O/Os must use a container made of or lined with material that will not react with the hazardous waste to be stored in the container.
- **264.175(b)** - A containment system must have the following:
 - a base underlying the container that is free of cracks and is impervious so as to contain leaks and spills until collected;
 - a base that is sloped or a containment system designed so that liquids from leaks can be drained and removed;
 - sufficient capacity to contain 10 percent of the volume of containers or the volume of the largest container, whichever is greater. Containers that do not contain free liquids do not have to follow this requirement; and
 - a method of preventing run-on into the containment system unless the system has sufficient excess capacity to contain the run-on. Spilled or leaked waste must be removed from the sump or collection area to prevent overflow.

10. SUBPART J - Specific Requirements for Tank Systems

- The requirements of this section do not apply to tank systems that do not contain free liquids and are inside a building with an impermeable floor, and tank systems, including sumps, that are part of a secondary containment system.
- **264.191** - For each existing tank system that does not have secondary containment, O/Os must assess the tank system to determine whether it is adequately designed and is structurally sufficient to store waste. Minimum requirements for assessment are provided. Requirements include assessment of the design, assessment of the tank, material used, and components of external shell.
- **264.192** - O/Os of new tank systems must submit to the Regional Administrator, with the submittal of Part B application information, a written assessment, reviewed and certified by an independent, qualified registered professional engineer, attesting that the tank system has sufficient structural integrity and is acceptable for storing waste.
- **264.193** - Secondary containment must be provided for:
 - all new tank systems and components prior to being put into service;
 - existing tank systems for which the age cannot be determined, within two years of January 12, 1987 or when the tank system has reached 15 years of age, whichever comes later;
 - existing tank systems for which the age cannot be determined, within eight years of January 12, 1987; if the age of the facility is greater than seven years, secondary containment must be provided by the time the facility reaches 15 years of age, or within two years of January 12, 1987, whichever comes later; and
 - tank systems that store or treat materials that become hazardous wastes after January 12, 1987, within the time intervals required by the preceding paragraphs, except that the date that a material becomes a hazardous waste must be used in place of January 12, 1987.
- **264.193(c)** - Specifies the following construction requirements for secondary containment systems that must be met:
 - constructed of or lined with material that is compatible with the waste that will go inside the tank;
 - placed on a foundation or base capable of supporting the system, resistant to pressure gradients above and below the system, and capable of preventing failure due to settlement, compression, or uplift;
 - provided with a leak-detection system designed so that it will detect failures of the system within 24 hours, or within the earliest practicable time if the O/O can demonstrate that existing detection systems will not allow detection within 24 hours; and
 - sloped or otherwise designed or operated to drain and remove liquids that leak or spill.
- **264.193(d)** - Secondary containment for tanks must include one of more of the following:
 - a liner external to the tank;
 - a vault;

- a double-walled tank; or
- an equivalent device approved by the Regional Administrator.
- **264.196** - Requirements for response to leaks: prevent flow or addition of wastes; remove waste from tank; contain visible release; and provide secondary containment.

11. SUBPART K - Specific Requirements for Surface Impoundments

- **264.221(a)** - Existing surface impoundments must have a liner that is designed, constructed, and installed to prevent any migration of wastes to the subsurface soil or surface and ground water for the active life, including the closure period, of the impoundment. The liner may allow wastes to migrate into the liner.
- **264.221(b)** - An O/O can be exempted from design requirements if he can show that an alternative design will prevent migration of wastes.
- **264.221(c)** - Each new surface impoundment, each new surface impoundment at an existing facility, and each replacement of an existing surface impoundment must have two or more liners and a leachate collection system between the liners.
- **264.228** - Closure and post-closure care requirements. (See section 5 above.)
- **264.230** - Incompatible wastes must not be placed in the same surface impoundment.

12. SUBPART L - Specific Requirements for Waste Piles

- **264.250(a)** - Regulations apply to O/Os of facilities that treat, store, or dispose of wastes in waste piles.
- **264.250(b)** - The regulations do not apply to O/Os of waste piles that are closed with wastes left in place; these waste piles are regulated as landfills. The regulations do not apply to O/Os of waste piles that are inside or are protected from precipitation provided that:
 - liquids or materials containing free liquids are not placed in the pile;
 - the pile is protected from surface water run-on;
 - the pile is designed and operated to control dispersal of the waste by wind or means other than by water; and
 - the pile will not generate leachate through decomposition.
- **264.251(a)** - A waste pile must have:
 - a liner that prevents migration of any wastes out of the pile into adjacent subsurface soil and surface and ground water during the active life of the pile, including the closure period. The liner may allow wastes to migrate into the liner itself; and
 - a leachate collection and removal system above the liner.
- **264.251(b)** - An O/O can be exempted from design requirements if he can show that an alternative design will prevent migration of wastes.
- **264.251(c)** - O/Os must design, construct, operate, and maintain a run-on control system capable of preventing flow onto the active portion of the pile during peak discharge from at least a 25-year storm.
- **264.251(d)** - O/Os must design, construct, operate, and maintain a run-off management system to collect and control water volume resulting from a 24-hour, 25-year storm.
- **264.251(f)** - Any particulate matter subject to wind dispersal must be covered.

- **264.257** - Incompatible wastes must not be placed in the same waste pile.
- **264.258** - Closure and post-closure care requirements. (See section 5 above)

13. SUBPART M - Specific Requirements for Land Treatment

- **264.271(a)** - O/Os who use land treatment must establish a program designed to ensure that hazardous constituents placed in or on the treatment zone are degraded, transformed, or immobilized within the treatment zone. The Regional Administrator will specify in the permit the requirements of the program.
- **264.271(c)** - The Regional Administrator will specify the vertical and horizontal dimensions of the treatment zone. The maximum depth of the treatment zone must be no more than 1.5 meters (5 feet) from the initial surface soil and more than 1 meter (3 feet) above the seasonal high water table.
- **264.272(a)** - Before applying the waste to the treatment zone, the O/O must demonstrate, for each waste, that the hazardous constituents in the waste will be completely degraded, transformed, or immobilized in the treatment zone.
- **264.272(b)** - In performing the demonstration, the O/O can use field tests (must obtain a treatment and disposal permit), laboratory analysis, available data, or operating data if an existing facility.
- **264.273(a)** - O/Os must design and operate a facility in accordance with all of the operating conditions that were used in the demonstration.
- **264.273(b)** - O/Os must design, construct, operate, and maintain the treatment zone to minimize run-off of hazardous constituents.
- **264.273(c)** - O/Os must design, construct, operate, and maintain a run-on control system capable of preventing flow onto the active portion of the pile during peak discharge from at least a 25-year storm.
- **264.273(d)** - O/Os must design, construct, operate, and maintain a run-off management system to collect and control water volume resulting from a 24-hour, 25-year storm.
- **264.273(f)** - Any particulate matter subject to wind dispersal must be covered.
- **264.276(a)** - Food-chain crops can be grown on land treatment zones if the O/O can demonstrate that there is no substantial risk to human health caused by the growth of the crops on the zone. The demonstration must show that the hazardous constituents (other than cadmium) will not be transferred to the plants by plant uptake, or will not occur in concentrations greater than those found in the same plants not grown in treated soil.
- **264.276(a)(3)** - This demonstration can be made through field tests, greenhouse studies, available data, or operating data for existing facilities.
- **264.276(a)(4)** - O/Os must obtain a permit for field and greenhouse testing.
- **264.276(b)** - If cadmium is contained in the waste, the following conditions apply:
 - the pH of the waste and soil mixture must be 6.5 or greater at the time of each waste application, except for waste containing cadmium at concentrations of 2 mg/kg (dry weight) or less;

- the annual application of cadmium from waste must not exceed 0.5 kilograms per hectare (kg/ha) on land used for tobacco, leafy vegetables, or root crops grown for human consumption. For other food-chain crops the annual application rate must not exceed 0.5 kg/ha beginning January 1, 1987;
- the cumulative application of cadmium must not exceed 5 kg/ha if the waste and soil mixture has a pH of less than 6.5; and
- if the pH is 6.5 or greater or is maintained at a pH of 6.5 or greater during crop growth, the cumulative application must not exceed 5 kg/ha if soil cation exchange capacity (CEC) is less than 5 meq/100g; 10 kg/ha if CEC is 5-15 meq/100g; and 21 kg/ha if CEC is greater than 15 meq/100g.
- **264.276(b)(2)** - If animal feed is the only crop produced, the pH must be 6.5 or greater at the time of waste application or at the time the crop is planted, whichever is later. This pH level must be maintained during crop growth.
- **264.276(b)(2)(iii)** - A plan must be prepared showing how the crop will be distributed to assure that the crop is not consumed by humans.
- **264.278(a)** - O/Os must monitor the soil and soil-pore liquid to determine whether hazardous constituents have migrated out of the treatment zone.
- **264.280** - Closure and post-closure care requirements. (See section 5 above)

14. SUBPART N - Specific Requirements for Landfills

- **264.301(a)** - All existing landfills must have a liner system for all portions of the landfill. The liner system must:
 - have a liner that prevents any migration of wastes to adjacent subsurface soil and surface and ground water during the active life of the landfill, including the closure period. The liner must prevent wastes from passing into the liner itself; and
 - have a leachate collection system above the liner.
- **264.301(b)** - An O/O can be exempted from the design requirements if he can show that an alternative design prevents migration of wastes.
- **264.301(c)** - O/Os of a new landfill, a new landfill unit at an existing facility, a replacement of an existing landfill unit, or a lateral expansion of an existing landfill unit, must install two or more liners and a leachate collection system above and between the liners. An O/O can satisfy the requirements of this section by installing a top liner that prevents migration of any constituent into the liner and a lower liner that prevents migration of constituents through the liner.
- **264.301(d)** - The double liner requirement will not apply if the O/O can demonstrate that an alternative design will prevent the migration of any hazardous constituents into the ground water.
- **264.301(f)** - The landfill must have a run-on control system capable of preventing flow from at least a 25-year storm onto the active portion of the pile during peak discharge.
- **264.301(g)** - The landfill must have a run-off management system to collect and control water volume resulting from a 24-hour, 25-year storm.
- **264.301(h)** - Collection and holding facilities for run-on and run-off control systems must be emptied after storms.
- **264.301(i)** - Any particulate matter subject to wind dispersal must be covered.
- **264.310** - Closure and post-closure care requirements. (See section 5 above)

- **264.314(b)** - Effective May 8, 1985, bulk or non-containerized liquid hazardous waste cannot be placed in a landfill.
- **264.314(c)** - O/Os must perform a test to demonstrate the absence or presence of free liquids in either bulk or containerized waste.
- **264.314(e)** - Effective November 8, 1985, no liquids can be placed in a landfill unless the Regional Administrator determines that:
 - the only other alternative is placement in a landfill or an unlined surface impoundment that contains hazardous waste; and
 - placement in the landfill will not contaminate ground water.

15. PART 268 - Land Disposal Restrictions

- In the final rule for the Third Third land disposal restrictions (LDRs), EPA classified mineral processing wastes that have been taken out of the Bevill exemption as "newly identified" wastes. Consequently, BDAT for mineral processing wastes that exhibit hazardous characteristics (e.g., corrosivity, EP toxicity) will not apply, even if these wastes are removed from the Mining Waste Exclusion until EPA, by separate rulemaking, establishes standards for these wastes under §3004(g)(4). Nonetheless, when newly identified wastes are mixed with other prohibited waste, the newly identified wastes are subject to existing hazardous waste prohibitions.

Appendix E-2

**Subtitle D-Plus Regulatory
Program Scenario**

Appendix E-2

Subtitle D-Plus Regulatory Program Scenario

This regulatory scenario constitutes one possible approach to a RCRA Subtitle D program for some or all special wastes from mineral processing that remain within the Mining Waste Exclusion. The approach described here has been developed solely for analytical purposes by staff of EPA's Special Wastes Branch of the Office of Solid Waste, and is tailored to address some of the special characteristics of mineral processing wastes. The reason for inclusion of a Subtitle D scenario in this report is that the Agency is presently developing a tailored program to address mineral extraction and beneficiation wastes under Subtitle D (referred to herein as a "D-Plus" program), and would consider applying this program to any of the 20 mineral processing wastes subject to this study that remain excluded from regulation under RCRA Subtitle C after the regulatory determination that will follow, and be based upon, this report. The following presents a summary discussion of the scope and various requirements of the RCRA Subtitle D-Plus program scenario crafted for use in this Report to Congress.

Applicability and Permits

- Owners/operators of existing units must be in compliance with all applicable provisions of the rule by the compliance date established by the regulatory authority (i.e., a state with an approved program or EPA when implementing a state program), which may be no later than five years following EPA approval of the state mining waste management plan or the federal implementation of a state plan. Because states will have up to roughly three and one-half years to develop a mining waste program, the compliance date could fall anywhere from roughly six to nine years after the promulgation of the federal rule, with eight years following federal promulgation being a reasonable average.
- New units (i.e., units that begin receiving waste after the compliance date) must be in compliance upon the initiation of activity.
- Compliance entails meeting all technical criteria, having completed all appropriate plans and assessments (e.g., closure plans), and having all required permits in place. All requirements are unit-specific.

Waste Characterization

- Owners/operators of all existing and new units must perform, for each unit, a characterization of the regulated wastes currently or to be managed in the unit, and must update that characterization at least once every five years. This characterization must include:
 - A total constituent analysis, using SW-846 or equivalent methods, for arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver (i.e., TC metals listed at 40 CFR § 261.24 Table 1);
 - A total constituent analysis for radionuclides;
 - A total constituent analysis for any other parameters identified by the state;
 - A measure of acid generation potential;
 - A quantitative assessment of the potential variability in the composition of the regulated material being managed;
 - A minimum site characterization (e.g., environmental setting, climate, land/natural resource setting); and
 - A description of the characterization protocols used by the owner/operator.

- Based on these analyses, the owner/operator must identify any and all "parameters of concern" present in the unit. ("Parameter of concern" is not clearly defined, but most likely will be defined either explicitly or de facto to include any TC metal present in a measurable concentration and any other parameter, such as pH, existing in a manner likely to pose an environmental risk).

Performance Standards

- If one or more parameters of concern are identified for a given unit, the regulatory authority must establish performance standards for those parameters. In order to establish performance standards, owners/operators must assess the potential for releases of any of the parameters of concern from the unit to the environment via ground water, surface water, air, or soils and surficial materials. The regulatory authority may waive the requirement for establishing surface water performance standards if the owner/operator demonstrates that the concentration of the parameter of concern in the regulated unit could not result in a discharge exceeding the potential performance standard. The regulatory authority may waive the requirement for establishing air or soils/surficial materials performance standards if the owner/operator demonstrates that the management practices being performed eliminate the potential for release to these media.
- The rule establishes methodologies that the regulatory authority must follow in developing ground water, surface water, air, and soils and surficial materials performance standards. These methodologies give precedent to established state numeric standards (which must be at least as stringent as corresponding federal standards), followed by federal numeric standards (i.e., MCLs), and finally site-specific risk-based standards. In all cases, if background concentrations exceed the applicable numeric standard then background becomes the performance standard. The point of compliance generally is no further than the actual or anticipated unit boundary.

Design and Operating Criteria

- Owners/operators of all existing and new units containing one or more parameters of concern for which performance standards were established must comply with both general and, if relevant, site-specific design and operating criteria. Actual design and operating criteria requirements are left largely to the discretion of the regulatory authority.
- The general criteria require that owners/operators ensure "the continued structural stability of (the unit), and that releases from (the unit) that exceed performance standards and/or catastrophic failure do not occur." Structural stability must be maintained throughout the unit's entire active, closure, and post-closure care periods. Owners/operators also must control human and wildlife access to, and contact with, regulated materials that might pose a human health or environmental risk. Owners/operators are prohibited from disposing of RCRA hazardous wastes in the regulated unit. In addition to these mandates and prohibitions, the general criteria require that owners/operators institute a run-on/run-off control system such that run-off from the unit will not cause a discharge of pollutants to waters of the U.S. This run-on/run-off control system also must be placed in a configuration at closure that allows for restoration of the natural drainage network to the extent practicable.
- The general design and operating provisions of the rule also contain unit-specific criteria as follows:
 - Existing surface impoundments must maintain sufficient freeboard to prevent overtopping;
 - New surface impoundments must be designed to prevent overtopping;
 - Land application of regulated materials as soil amendments cannot begin until the owner/operator assesses potential threats to human health and the environment from potential releases and human contact (i.e., performance standard exceedances), establishes a plan detailing application rates, and provides for periodic sampling of the applied materials; and
 - Land application of regulated materials as a treatment process can take place only after the owner/operator completes a soil and surficial material protection plan that incorporates, as necessary, vadose zone monitoring, periodic measures of the soil treatment zone depth, a characterization of the uppermost aquifer, test plots to monitor migration, measurements of soil loadings of pollutants, and periodic reports.

- Finally, the general design and operating provisions require that owners/operators submit information and take steps necessary to ensure the protection of biological resources, including unit access control, as necessary, and compliance with the Endangered Species Act of 1973.
- In addition to these general criteria, units located in certain sensitive areas (as defined by the rule) must meet location-specific design and operating criteria that are intended to ensure that releases do not occur in exceedance of performance standards. These criteria are as follows:
 - FLOODPLAINS (100 year) - Owners/operators must assess the effect of the unit on the restriction of flow of surface waters, the reduction or temporary loss of water storage and conductance capacity in the floodplain, and the potential for washout of regulated materials and resulting contaminant releases. The regulatory authority may require modifications to existing units, or design plans for new units, as necessary to protect human health and the environment, based on the owner/operator's assessment.
 - WETLANDS - Units located in wetlands (as defined by the rule) must comply with all applicable CWA § 404 provisions and provisions of the Marine Protection, Research and Sanctuaries Act of 1972. The regulatory authority may require modifications to new or existing units in order to ensure that performance standards are met.
 - SEISMIC IMPACT ZONE (i.e., any area where the probability is greater than or equal to 10 percent that the maximum horizontal acceleration in lithified earth material will equal or exceed 0.20 g in 50 years) - Owners/operators of existing units may be required to modify the design and/or to implement operating requirements necessary to ensure structural stability at the discretion of the regulatory authority. Owners/operators of new units containing regulated materials with high moisture contents must design, construct, and operate those units to withstand the maximum horizontal acceleration from seismic impacts during operation. Other new units must be designed, constructed, and operated to ensure structural stability.
 - UNSTABLE AREAS (e.g., areas with landslide potential or in the path of potential rock slides or avalanches) - Owners/operators of existing units may be required to modify the design and/or to implement operating requirements necessary to ensure structural stability at the discretion of the regulatory authority. Owners/operators of new units must demonstrate that the proposed design of the unit is adequate to ensure the stability of all structural components of the unit during operation, closure, and post-closure care.
 - FAULT AREAS (i.e., within 61 meters of a fault having had displacement within Holocene time) - Owners/operators of existing units may be required to modify the design and/or to implement operating requirements necessary to ensure structural stability at the discretion of the regulatory authority. Owners/operators of new units must demonstrate that any movement along the fault and in the adjacent zone of deformation will not disrupt the contents of the unit or damage the structural stability of the unit such that applicable performance standards would be exceeded.
 - KARST TERRANE (i.e., areas where karst topography exists as the result of dissolution of limestone, dolomite, or other soluble rock) - Owners/operators of new and existing units must demonstrate that performance standards for ground and surface water will be met during construction, operation, closure, and post-closure care. At the discretion of the regulatory authority, owners/operators must undertake a study that: 1) demonstrates, based on hydrogeologic analyses, that the unit(s) is in fact within a Karst Terrane; 2) characterizes the degree of stability and potential subsidence of the unit(s) based on the historical changes in regional and local water levels and on the history and presence of sinkhole development during Holocene time; and 3) demonstrates, based on engineering analysis, that the unit will not lose its structural stability. The regulatory authority may require the modification of existing units, or the modification of new unit plans, at its discretion based on the owner/operator's analyses.
 - PERMAFROST (i.e., areas where water within surface and subsurface material persists in a frozen or partially frozen state throughout the year) - Owners/operators of existing units underlain by permafrost may be required to modify the design and/or to implement operating requirements necessary to ensure structural stability at the discretion of the regulatory authority. Owners/operators of new units underlain by permafrost must design, construct, and operate those units to ensure structural stability.
 - WELLHEAD PROTECTION AREAS (i.e., areas surrounding public water supply wells) - Owners/operators must conduct a study to determine whether the regulated unit is in fact within

a wellhead protection area, as defined by state or federal criteria. If the regulated unit is within a wellhead protection area, the regulatory authority may require the modification of existing units, or the plans for new units, to ensure that contaminants for which performance standards were established will not be released.

Monitoring

- Most of the monitoring requirements under this regulatory approach are media-specific, addressing ground water, surface water, air, and soils and surficial materials. For each of these media, the owner/operator must perform an assessment of the potential for releases of parameters of concern from the regulated unit, other than surface water discharges permitted under § 402 of the Clean Water Act or air emissions authorized under the Clean Air Act. The regulatory authority may then exempt an owner/operator from monitoring a given medium for a given parameter if, based on the owner/operator's assessment, the regulatory authority determines that there will be no release from the unit exceeding that parameter's performance standard for the medium. For any parameters of concern not exempted from monitoring, the owner/operator must establish a monitoring system that is capable of characterizing the background quality of the medium and the extent of contamination, if any, caused by a release. The media-specific technical monitoring criteria are summarized below.
- **GROUND WATER** - For any parameters of concern not exempted by the regulatory authority from ground-water monitoring, the owner/operator must establish a ground-water monitoring system that is capable of characterizing any release of those parameters of concern from the unit in violation of respective performance standards. This ground-water monitoring system must comply with a ground-water monitoring plan that considers the hydrogeologic setting, number and placement of wells, and the sampling protocol necessary to adequately characterize background water quality and water quality at the point of compliance. The owner/operator also must indicate what protocols and statistical methods will be used to determine that an exceedance of a performance standard has occurred. If the exceedance of a performance standard is detected and verified, the owner/operator must undertake a corrective action plan (as described below).
- **SURFACE WATER** - The emphasis of this regulatory approach is to promote the adoption of management practices allowing the waiver of monitoring of surface water in lieu of the establishment of a surface-water monitoring system. Nonetheless, for any parameters of concern not exempted by the regulatory authority from surface water monitoring, the owner/operator must establish a surface water monitoring system that is capable of characterizing any release of those parameters of concern from the unit in violation of the respective performance standards. This surface water monitoring system must adopt protocols necessary to ensure the accurate characterization of the receiving surface water quality (i.e., background) and the quality of discharges from the unit. Sampling must be undertaken at least quarterly. If the exceedance of a performance standard is detected and verified, the owner/operator must undertake a corrective action plan (as described below).
- **AIR** - The emphasis of this regulatory approach is to promote the adoption of management practices allowing the waiver of monitoring of air in lieu of the establishment of an air monitoring system. Nonetheless, for any parameters of concern not exempted by the regulatory authority from air monitoring, the owner/operator must establish an air monitoring system that is capable of characterizing any release of those parameters of concern from the unit in violation of the respective performance standards. This air monitoring system must adopt protocols necessary to ensure the accurate characterization of the background air quality (as measured at an upwind point specified by the regulatory authority) and the concentration of parameters of concern at the point of compliance. The point of compliance for air emissions under this regulatory approach generally will be the facility boundary. Sampling must be undertaken at least quarterly. If the exceedance of a performance standard is detected and verified, the owner/operator must undertake a corrective action plan (as described below).
- **SOILS AND SURFICIAL MATERIALS** - The emphasis of this regulatory approach is to promote the adoption of management practices allowing the waiver of monitoring of soils and surficial materials in lieu of the establishment of a soils/surficial materials monitoring system. Nonetheless, for any

parameters of concern not exempted by the regulatory authority from soils/surficial materials monitoring, the owner/operator must establish a soils/surficial materials monitoring system that is capable of characterizing any potential release of those parameters of concern from the unit in violation of respective performance standards. This soils/surficial materials monitoring program must adopt protocols necessary to ensure the accurate characterization of the concentrations of parameters of concern in native soils samples and the concentration of parameters of concern at the point of compliance. Sampling must be undertaken at least quarterly. If the exceedance of a performance standard is detected and verified, the owner/operator must undertake a corrective action plan (as described below).

- In addition to these media-specific monitoring criteria, owners/operators must comply with provisions for the verification of design and operating criteria. The regulatory authority must specify protocols for the inspection of units by qualified professionals in order to ensure continued compliance with all applicable design and operating criteria during operational, closure, and post-closure care periods. If the regulatory authority determines and verifies that one or more of the applicable design and operating criteria have been violated, the owner/operator must undertake a corrective action plan.

Corrective Action

- If, based on the results of the monitoring activities required above, the regulatory authority determines that one or more performance standards have been exceeded at a regulated unit,¹ the owner/operator must undertake corrective action. The owner/operator's corrective action activities must follow an approved corrective action plan that 1) is protective of human health and the environment, 2) proposes a remedy that controls the source(s) of release and ensures compliance with the performance standard(s), and 3) proposes a schedule for initiating and completing corrective action. This corrective action plan must be completed within one year of the determination of exceedance.
- If, based on the results of the verification requirements for design and operating criteria compliance as described above, any defects in a regulated unit are found, or if the unit is not in compliance with the design and operating criteria for some other reason (e.g., structural failure), then the owner/operator must submit a corrective action plan that 1) ensures protection of human health and the environment, 2) provides a remedy that ensures compliance with applicable design and operating criteria throughout operation, closure, and post-closure care, and 3) specifies a schedule for initiating and completing corrective action. In developing the plan, the owner/operator must consider the extent and potential impacts of non-compliance; the capability of the selected remedy to achieve compliance; and other relevant factors specified by the regulatory authority. Once the correction action plan is approved by the regulatory authority, the owner/operator must complete corrective action according to the plan.

Closure/Post-Closure Care

- The purpose of closure and post-closure care is to ensure the continued structural stability of the unit and integrity of systems designed to ensure compliance with all performance standards and design and operating criteria. To this end, all units must continue to comply with all applicable design and operating criteria, monitoring criteria, and corrective action requirements throughout the closure and post-closure care periods.
- Closure must include a final regulated materials characterization and may entail further the removal of all regulated materials from the unit, actions to neutralize or immobilize parameters of concern, or other actions necessary to ensure permanent compliance with applicable performance standards and design and operating criteria (e.g., structural stability). If regulated materials remain in the unit, the owner/operator must add a notation to the property deed indicating the presence of the material, what

¹ Unlike the RCRA Subtitle C program, corrective action for solid waste management units other than regulated units would not be required under this scenario.

it consists of and what parameters of concern are present, and the anticipated post-closure land use for the area.

- An owner/operator must conduct closure in accordance with the closure plan, which must be completed and approved prior to the receipt or management of regulated materials, for the unit(s) in question. The closure plan must include a description of the activities necessary to ensure adequate closure at any point during the life of the unit, addressing continued compliance with performance standards, continued structural stability, access control, and any other relevant design and operating criteria. The closure plan also must be certified by a qualified professional (as defined by the rule) and must be established as part of an enforceable permit.
- Closure is triggered by 24 months of inactivity and must be completed within five years of the initiation of closure activities.
- Owners/operators must conduct post-closure care for all units in which regulated materials are present, unless the owner/operator demonstrates that ongoing maintenance and monitoring is not necessary to ensure continued compliance with all relevant performance standards and other technical criteria.
- An owner/operator must conduct post-closure care in accordance with the post-closure care plan, which must be completed and approved prior to the receipt or management of regulated materials, for the unit(s) in question. The post-closure care plan must include a description of the activities necessary to ensure continued compliance with all applicable performance standards and technical criteria, including structural stability, access control, activities necessary to maintain a final cover, control erosion, or to control fugitive dust. The post-closure care plan also must be certified by a qualified professional (as defined by the rule) and must be established as part of an enforceable permit.
- Post-closure care must be initiated immediately following the certification of closure and must continue for 30 years, unless the regulatory authority modifies the length of the post-closure care period.

Financial Responsibility

- Financial responsibility must be maintained by all owners/operators of existing and new units for 1) closure and, if applicable, post-closure care; 2) corrective action for known releases of parameters of concern in violation of performance standards or for design and operating criteria violations; and 3) third-party bodily injury and property damage caused by releases of parameters of concern.
- Financial responsibility for closure and post-closure care must be based on comprehensive cost estimates, in current dollars, for all planned activities assuming that the work will be performed by a third party. Costs must be adjusted annually for inflation until closure and post-closure care is certified complete. These cost estimates must be included as a condition of an enforceable permit.
- Financial responsibility for corrective action must be based on a detailed cost estimate for performing all necessary activities according to the approved corrective action plan. The owner/operator must base the initial cost estimate on current dollars and the assumption that the work will be performed by a third party. The approved corrective action cost estimate must be included as a condition of an enforceable permit.
- Financial responsibility for third-party bodily injury and property damage caused by a release must be maintained by the owner/operator in an amount of at least \$2 million per occurrence with an annual aggregate of at least \$4 million, exclusive of legal defense costs. The owner/operator must demonstrate this financial responsibility coverage as part of an enforceable permit prior to the operation of the unit. The regulatory authority may, at its discretion, release the owner/operator from third-party liability financial responsibility for a given unit upon receiving certification that, at a minimum, closure of the unit has been completed.
- Financial responsibility in all cases must be maintained continuously until the regulatory authority formally releases the owner/operator following the completion of corrective action, closure, or post-closure care, as appropriate. Allowable financial responsibility mechanisms must ensure timely, adequate, and legally binding coverage and may not be cancelled without approval of the regulatory

authority. Allowable mechanisms may include insurance pools, state funds, "or other such mechanisms" to demonstrate compliance with the financial responsibility requirements of the rule.

Appendix E-3

Description of Cost Model and Assumptions

Appendix E-3

Description of Cost Model and Assumptions

This appendix provides supplementary information on the methods, data, and assumptions that were employed to estimate the costs and impacts of prospective regulatory alternatives for controlling releases from special mineral processing wastes. The appendix is divided into two sections. The first outlines the legal and operational requirements of each alternative, and the second describes the development and application of EPA's cost estimating model.

1. Engineering/Operational Implications of Regulatory Scenarios

This section details the way in which prospective regulatory requirements translate into the "on the ground" waste management strategies that would be employed by affected facility operators. EPA's approach in performing this analysis was to delineate all of the applicable requirements comprising each regulatory scenario, then develop plausible waste management sequences, or "trains" for each of the potentially affected special mineral processing wastes. Plausible management practices or trains are influenced by the physical and chemical characteristics of the wastes in question, and by waste generation rates (all of which are, by definition, large), as well as by specific statutory and regulatory requirements.

Management costs associated with each pertinent regulatory scenario are estimated for each facility by identifying the specific items (and their costs) that are currently employed (in the baseline case) and that would be required under the regulatory alternatives. EPA utilized data contained in facility responses to the 1989 SWMPF survey to characterize current practices. The Agency then calculated the costs associated with each practice employed (e.g., design, construction, and operation of an unlined surface impoundment, waste stabilization, installation and operation of ground water, surface water, and/or air monitoring equipment); the sum of these costs is the total management cost at a given facility.

This technology- and facility-specific approach has resulted in management cost estimates that vary widely among facilities, even among those in the same commodity sectors. For example, EPA's cost estimate for baseline practices accounts for the presence of waste management controls such as run-on and run-off control systems and ground water monitoring. Facilities that currently employ these controls have higher current (baseline) waste management costs (all else being equal) than facilities that do not. Consequently, prospective Subtitle C or other regulation, and its attendant technical requirements (e.g., run-on and run-off controls, ground water monitoring) have reduced compliance cost implications at such facilities. Because EPA's cost analysis relies upon individual cost elements rather than unified cost functions, this variability in current waste management cost and, therefore, the incremental waste management cost associated with regulatory alternatives, can be accounted for in full.

Baseline Scenario

The baseline, or "No Action", regulatory scenario assumes that existing waste management practices will remain unchanged. The waste management practices discussed in the sector-specific chapters of this report comprise the waste management technologies employed under this scenario. In virtually all cases, assumed current waste management practices are based upon information submitted to EPA in the form of responses to the 1989 National Survey of Solid Wastes from Mineral Processing Facilities. In the few instances in which management practice information was missing or incomplete, the Agency assigned one or more management technologies based upon knowledge of the common practices used by other similar (e.g., same commodity sector and size of operation) facilities.

The most common current waste management technologies for solid and some sludge materials include placement in on-site, unlined landfills; waste piles without a cover or a base; gypsum stacks; and recycling. Wastewaters tend to be managed in on-site, unlined surface impoundments (some in combination with a gypsum stack); and in a few cases, synthetic- or clay-lined surface impoundments. Some portion of these wastewater streams is recycled at nearly all facilities.

A few facilities already meet the technical requirements of RCRA Subtitle C and are in fact, fully permitted Subtitle C Treatment, Storage, and Disposal Facilities (TSDFs). Such facilities are already subject to many of the requirements that are evaluated in this report (e.g., Subtitle C financial assurance, corrective action for continuing releases requirements), and hence, would not experience incremental compliance costs associated with these specific regulatory requirements if the special waste(s) that they generate were to be removed from the Mining Waste Exclusion. EPA has, accordingly, reflected this fact in conducting its cost and economic impact analysis.

The baseline scenario for the industry sectors covered by this report would occur under a regulatory determination by EPA that none of the solid wastes that are currently excluded from regulation under Subtitle C of RCRA by the Bevill Amendment require regulation as hazardous wastes. Even with such a regulatory determination, however, some changes in waste management practices may be required. The mineral processing industry, which has historically been exempt from federal hazardous waste management regulations under RCRA, has recently had this protection removed by a series of EPA rulemakings that were concluded on January 23, 1990 (55 FR 2322). As of the effective date of this notice (July 23, 1990 in non-authorized states), all mineral processing wastes except the 20 specific wastes considered in this report are subject to regulation as hazardous wastes (i.e., under RCRA Subtitle C) if they exhibit one or more characteristics of hazardous waste. EPA believes that many of the facilities considered in this report generate wastes that are newly subject to these requirements. Consequently, existing "baseline" management practices that are currently applied to special wastes at some of these facilities may change even if these materials are not removed from the Mining Waste Exclusion.

In addition, several states have imposed or are in the process of imposing new regulatory requirements on the operators of mineral processing facilities. For example, the State of Florida has issued a policy directive requiring that all new phosphogypsum stacks or lateral expansions of existing stacks have a clay liner; the State Department of Environmental Regulation has also indicated that it plans to initiate a formal rulemaking process for the development of phosphogypsum management regulations.

Full Subtitle C Scenario

The full Subtitle C ("Subtitle C") scenario examined here for the special study wastes is based on the premise that any of the 20 wastes exhibiting risk in the risk assessment process described above, including any that exhibit one or more RCRA hazardous characteristics (EP-toxicity, corrosivity, ignitability, or reactivity) may be regulated under Subtitle C and would then be subject to the technical requirements of 40 CFR Part 264.

EPA has examined the full array of Subtitle C regulatory requirements, and has identified those that would be most relevant from the standpoint of managing mineral processing wastes. These regulatory provisions are summarized in Appendix E-1 to this document.¹ The Agency then identified and categorized all requirements having potential cost implications.

Permitting and Administrative Requirements

In this cost impact analysis, EPA has explicitly considered and developed the cost implications of bringing a facility into the Subtitle C hazardous waste management system for the first time. Because of the high volume nature of the wastes considered in this report, the Agency believes that on-site treatment and/or disposal of these materials will continue to be the predominant means of management employed by facility operators, irrespective of the regulatory environment that may be imposed. This suggests that if any of the 20 wastes are placed into the Subtitle C system, the

¹ Appendix E-1 is not designed to be an exhaustive list of all potentially applicable provisions of EPA's Subtitle C regulations.

facilities that generate them will endeavor to become fully permitted Subtitle C Treatment, Storage, and Disposal Facilities (TSDFs). Accordingly, EPA has, for this cost analysis, included the costs of developing the relevant permit applications (Part A and B) as well as necessary supporting studies, in estimating incremental Subtitle C compliance costs. Facilities that are already in the system (either as permitted TSDFs or as generators of one or more low volume hazardous wastes removed from the Mining Waste Exclusion in recent rulemakings) are assumed to experience a lesser (25 percent) expense associated with obtaining a Subtitle C permit modification for a new waste management unit.

Design and Operating Criteria

For this analysis, EPA has developed cost functions that describe the relationship between waste generation rate (hence, size/capacity of waste management units) and the cost of each component of a given waste management technology. That is, each element and its associated cost is evaluated individually at each site; these costs are then summed to yield the total cost of compliance with the relevant design and operating criteria. In this way, variable economies of scale (e.g., liner costs and ground-water monitoring costs may have different economies of scale) can be reflected in EPA's cost estimates.

Application of Assumed Waste Management Technologies

Under the Subtitle C scenario, the Agency assumes that facility operators will upgrade current waste management technologies, rather than adopt a different waste management practice or technology, unless an alternative practice would be prohibited or less costly. For example, if a waste is currently disposed in a clay-lined landfill, the waste is assumed to be disposed in a landfill with a double-synthetic liner over a clay liner to comply with Subtitle C requirements. Technologies not allowed under Subtitle C are replaced with similar technologies that comply with RCRA minimum technology requirements (e.g., disposal waste piles are replaced by RCRA landfills). Wastes currently sent to off-site disposal are assumed to continue to be managed off-site, at facilities in compliance with RCRA Subtitle C requirements unless construction and operation of new units would be less costly. Materials that are identified at some plants as being hazardous wastes may not, at other plants, be solid wastes due to alternative management practices (e.g., recycling). Internally recycled "hazardous wastes" (actually secondary materials) are assumed, under the full Subtitle C scenario, to continue to be recycled without process changes.

Some wastes currently managed using unique methods required special examination to determine the expected Subtitle C alternative management practice. For example, phosphogypsum and fluorogypsum are presently slurried with process wastewater (another special mineral processing waste) at their respective facilities, then piped to gypsum stack complexes (at most, but not all plants). Gypsum stack complexes consist of a pile containing the gypsum with an adjoining surface impoundment; these complexes serve the dual purpose of waste disposal and heat transfer (process water cooling). Gypsum slurry is pumped to one of several smaller impoundments located on top of the gypsum pile (stack), where the solids settle and eventually dewater. The process water percolates through the stack and is collected in a drainage ditch surrounding the stack complex. In some cases, the water in the ponds atop the stack is transported to the adjacent cooling pond directly.

Under Subtitle C, this practice would have to change radically. Waste gypsum would have to be disposed in a Subtitle C disposal surface impoundment. This would imply dramatic changes in the ways in which affected facilities maintain their present water balance, and in other operational factors. Although EPA is not in a position to develop sophisticated engineering analyses of such process changes that might be induced by Subtitle C regulation, the Agency has attempted to predict the actual operational consequences of imposing hazardous waste management requirements on these non-traditional waste management technologies.

Where current practice involves co-management of both potentially hazardous and non-hazardous wastes, EPA assumes that non-hazardous waste management will continue to occur in the existing waste management unit while the hazardous waste(s) will be managed in accordance with Subtitle C. The same assumption holds for situations where a potentially hazardous waste is co-managed with a mining waste. For example, copper calcium sulfate sludge which is currently disposed with mill (beneficiation) tailings would be segregated and sent to an appropriate Subtitle C management unit, but the mill tailings would continue to be disposed in the existing tailings pond. Co-management of

special mineral processing wastes, non-special mineral processing wastes, and/or mineral extraction and beneficiation wastes occurs under current practice in many of the industry sectors evaluated in this report.

In general, the assumption that alternative management will involve an upgrade of existing facilities is the most reasonable prediction of future alternative waste management, given the limited data available. EPA is aware, however, that firms will make operational adjustments in response to changes in the regulatory environment in which they operate. In response to minimum technology requirements, facility operators will seek the lowest-cost waste management practice that complies with the law. In some cases, this will undoubtedly involve using new and innovative technologies or adapting existing practices to manage wastes rather than upgrading existing land disposal facilities to comply with Subtitle C. For example, many plants that currently dispose of wastes will, under RCRA Subtitle C, be provided with financial incentives to reuse or reclaim those wastes.

Unfortunately, EPA is unable to accurately identify the specific plants at which special waste management would shift towards recycling or utilization of waste materials or non-traditional waste management techniques, without highly detailed information concerning facility-specific business management and development plans. The Agency has, however, indicated which wastes may be good candidates for waste utilization, reduction, and/or recycling, and provides a limited identification and evaluation of the options available to affected facilities.

Also, facilities currently treating and storing wastes in impoundments may shift to using tank storage and treatment. They may do so to avoid complying with the minimum technology requirements for hazardous waste land disposal units, or to take advantage of the RCRA Subtitle C exemption for wastewater treatment tanks. In general, EPA believes that facilities will employ tank treatment systems rather than or in conjunction with constructing minimum technology treatment surface impoundments, and has conducted its compliance cost analysis accordingly. The Agency has performed comparative cost analyses which indicate that tank treatment in concrete impoundments is the least-cost management alternative for the waste types and within the waste generation rate ranges that are relevant to this study.

Land Disposal Restrictions

In its evaluation of the likely response of facility operators to prospective Subtitle C regulation, EPA has considered the likely impact of the Land Disposal Restrictions (LDRs). These regulations were implemented in three parts, the last of which was promulgated on May 9, 1990. LDRs establish treatment standards (BDAT) for characteristic hazardous wastes, such that any wastes exhibiting a hazardous characteristic must be treated to a defined level/with a specified technology prior to disposal on the land (e.g., in landfills or surface impoundments). In the final rule establishing BDAT for characteristically hazardous wastes, EPA explicitly declined to establish BDAT for "newly identified" wastes, including those removed from the Mining Waste Exclusion in recent rulemakings (54 FR 36592, 55 FR 2322). By implication, any wastes considered in this report that are removed from the Exclusion would also be newly identified, hence, not subject to the "Third Third" Land Disposal Restrictions. Consequently, EPA has not factored the costs of complying with the BDAT provisions contained in this rule into the present analysis, e.g., EP-toxic slags are not assumed to be ground up and cement-stabilized prior to disposal.

Nonetheless, the Agency has attempted to reflect the intent of the Land Disposal Restrictions program in defining acceptable Subtitle C management practices for the wastes considered in this report. In some cases, EPA has employed best professional judgment to specify additional steps in the treatment trains that have been applied to individual wastes; these additional steps often parallel or are identical to the BDAT specified in the recent final rule. EPA believes that in this way, compliance cost estimates that more closely parallel real-world permit conditions have resulted. For example, several of the wastewater streams considered in this report are well known to exhibit pH values less than two. Consequently, they are currently (absent the Mining Waste Exclusion) prohibited from disposal on the land (e.g., in surface impoundments) unless they have been subjected to treatment using BDAT. EPA has assumed in its cost analysis that these wastes will undergo pH adjustment in tanks prior to extended storage in impoundments. Similarly, EP toxic wastewater treatment sludges are assumed to be cement-stabilized prior to Subtitle C landfill disposal.

Corrective Action

Based upon the results of the risk assessment and damage case collection activities described in the foregoing chapters, EPA believes that some of the wastes that have accumulated at mineral processing sites may release contaminants to the environment, and therefore, require corrective action. Accurately estimating the nature and extent of and the appropriate response to existing releases at the mineral processing facilities considered in this study would, however, be an extremely difficult and complex undertaking. Consequently, the Agency has not included an explicit analysis of potential corrective action costs in this report. EPA recognizes that the prospective regulatory compliance costs provided in this document may, therefore, be underestimates.

It is important to understand, however, that only facilities that are not already subject to corrective action and generate a waste that exhibits one or more characteristics of hazardous waste that is removed from the Exclusion would experience corrective action costs that are relevant to this report. The Agency has determined which of the facilities considered in this document might enter the Subtitle C system for the first time as a consequence of the upcoming Regulatory Determination, and hence, be newly subject to corrective action requirements. These facilities are limited to those that (1) are not already Subtitle C TSDFs, and (2) do not generate a low volume, hazardous waste that was removed from the Mining Waste Exclusion by either the 9/1/89 or 1/23/90 final rules. EPA has determined that the number of such facilities is small, and that most are within one commodity sector (phosphoric acid). Therefore, the Agency does not believe that omitting a quantitative analysis of corrective action costs materially affects the findings and recommendations presented in this report.

Closure and Post-Closure Care

Subtitle C regulations require facility operators to conduct prescribed closure and post-closure care activities. Closure for land disposal units involves capping with clay and a synthetic membrane liner, installation of a leachate collection and removal system, and a revegetated soil or rock cap. For this analysis, EPA has calculated the cost of closing waste management units at the expected conclusion of their operating life, and of the maintenance, monitoring, and contaminant release control systems required under current Subtitle C regulations. Because these activities (and their costs) will not occur until well into the future, closure and post-closure care costs have been discounted to present value, then added to the other cost components (capital, operation and maintenance costs) to arrive at a total waste management cost for a given unit. Additional detail on EPA's cost estimating methods is presented below.

Financial Responsibility

Facility operators in the Subtitle C system are required to provide evidence of their ability to bear the costs associated with closure and post-closure care requirements, and with potential third-party liability. Moreover, in actual practice, facility operators may be required to provide assurance of their ability to respond to both sudden and non-sudden contaminant releases from their units (corrective action), though EPA's final rule addressing financial assurance for corrective action has not yet been promulgated. For this analysis, EPA has factored in a cost to account for financial responsibility concerns for all facilities potentially subject to Subtitle C regulation. This cost varies among facilities, depending upon whether the firm owning the facility (or corporate parent) is able to pass the "Financial Test." Firms with adequate financial resources to pass this test experience a much lower effective cost for providing financial assurance than other firms.

Subtitle C-Minus Scenario

To assess the potential costs and impacts of less stringent regulation, EPA has evaluated an intermediate Subtitle C scenario ("Subtitle C-Minus") that assumes that EPA exercises all of the regulatory flexibility provided by Section 3004(x) of RCRA. Section 3004(x) does not give EPA authority to waive Subtitle C authority based on cost alone. Rather, this provision allows EPA to provide some regulatory flexibility to mitigate the economic impacts of Subtitle C regulation on the minerals industry provided that adequate protection of human health and the environment is ensured. This flexibility allows EPA to modify the relevant provisions to take into account the special characteristics of mining

and mineral processing wastes, practical difficulties in implementing the specific RCRA Subtitle C requirements, and site-specific characteristics.

As discussed in Chapter 2, this scenario uses the same assumptions as the full Subtitle C regulatory scenario, with three notable exceptions:

- The prohibition on placing liquids in Subtitle C landfills does not apply;
- Land Disposal Restrictions do not apply; and
- On-site waste management practices, for special mineral processing wastes meet only pre-HSWA Subtitle C technological requirements, rather than the minimum technology required under 3004(o) and 3005(j) of the amended RCRA.

Under the Subtitle C-minus scenario, therefore, EPA assumes that facilities continue to replace or expand disposal units without (generally) installing double liners and leachate collection systems, to dispose materials in landfills in slurry form, and to continue to manage wastes without applying BDAT prior to land disposal.

For purposes of estimating the costs of this regulatory alternative in this Report to Congress, EPA has identified what it tentatively believes would be the absolute minimum allowable extent of regulation under Subtitle C (i.e., the maximum allowable application of regulatory flexibility). As discussed in Chapters 1 and 2, however, EPA is in no way suggesting or implying that the model used for costing purposes in preparing this report represents what the Agency could legally or would determine is an appropriate application of RCRA §3004(x). EPA has solicited comments on whether this model reasonably reflects allowable practices under §3004(x). The Agency has applied regulatory flexibility under this scenario on a site-specific basis, taking into consideration not only existing waste management practices, but also the environmental settings (risk potential) of the individual facilities. Consequently, the requirements that apply to a facility in an environmentally sensitive area are more stringent under this scenario than they are for a facility located in an area with lower risk potential.

To establish the design and operating criteria that would apply to facilities under the Subtitle C-Minus scenario, EPA evaluated each potentially affected plant in terms of the vulnerability of the environmental media found at the site, focusing on ground water resources. Each facility was placed into a category (low, moderate, or high risk potential) based upon an evaluation of intrinsic site characteristics (e.g., depth to ground water, net recharge, soil composition), damage case findings, and risk analyses (quantitative modeling results) that was conducted for this report. The site-specific results of this effort are presented in Exhibit E-3-1. These categories determined the specific design and operating standards that were required for the facilities and, in fact, whether certain currently used management technologies (disposal waste piles) were even allowed under the Subtitle C-Minus scenario. These design and operating criteria are presented by risk potential category and management technology in Exhibit E-3-2.

Exhibit E-3-1
Ground-Water Contamination Potential of
Sites Modeled in the Cost/Economic Impact Analysis

Sector/Site	Ground-Water Contamination Potential	Rationale
PB/ASARCO/E. Helena, MT	Moderate	Observed contamination potentially attributable to slag pile, although there is also upgradient contamination and contamination downgradient may be due to former practice of sprinkling the pile for dust suppression; modeling also predicts slight contamination
PB/ASARCO/Glover, MO	High	Observed contamination that is likely attributable to slag pile; modeling also predicts contamination; karst terrane may facilitate contaminant migration
PB/ASARCO/Omaha, NE	Low	No observed contamination; modeling predicts no contamination in 200 years; very shallow ground water (2 m), but low net recharge (5 cm/yr) and impermeable unsaturated zone (primarily silt and clay)
PB/Doe Run/Boss, MO	Moderate	Observed contamination, although may be due to on-site impoundments; modeling predicts no contamination; low recharge (5 cm/yr) and large depth to ground water (45 m), but potential for karst terrane may facilitate contaminant migration
PB/Doe Run/Herc., MO	Low	No observed contamination; modeling predicts no contamination; ground water moderately shallow (8 m), but very low recharge (2 cm/yr) and impermeable unsaturated zone (silt and clay)
CU/ASARCO/Hayden, AZ	Low	Modeling predicts no contamination; ground water moderately shallow (6 m), but very low net recharge (1 to 2.5 cm/yr)
CU/Phelps/Playas, NM	Low	Although ground water shallow (4 m), essentially zero recharge
CU/Kennecott/Garfield, UT	Low	Ground water moderately shallow (8 m), but recharge very low (<1 cm/yr) and impermeable unsaturated zone (primarily silt and clay); modeling predicts no contamination in 200 years
MG/Magcorp/Rowley, UT	Low	Impoundment designed to have wastewater infiltrate into ground as a way to reduce volume; ground water shallow (5 m); subsurface permeable (primarily sand); State tracking seepage and indicates that it poses a low risk; low potential for exposure because shallow ground water is saline (connected with Great Salt Lake)
ZN/ZCA/Monaca, PA	Low	Although high recharge (25 cm/yr), ground water is deep (24 m); on-site monitoring has not identified any contamination; modeling predicts no contamination in 200 years
HA/Allied/Geismar, LA	Moderate	Standing quantity of process wastewater provides a hydraulic head to drive contaminants to shallow (3 m) ground water, and contamination seeps observed around the clearwell pond; however, shallow aquifer appears to discharge into river without use, and uppermost useable aquifer is deep (55 m)
FE/LTV/E. Cleveland, OH	Moderate/Low	Ground water deep (23 m); recharge moderate (15 cm/yr); unsaturated zone moderately permeable (loamy sand)

Exhibit E-3-1 (cont'd)

Ground-Water Contamination Potential of Sites Modeled in the Cost/Economic Impact Analysis

Sector/Site	Ground-Water Contamination Potential	Rationale
FE/Bethlehem/SparrowsPt, MD	Moderate	Ground water very shallow (2.5 m), recharge high (28 cm/yr), and unsaturated zone moderately permeable (loamy sand); however, low potential for exposure because shallow ground water brackish (not drinkable) and public water provided from distant supply
FE/Sharon/Farrell, PA	Moderate	Ground water shallow (5 m); recharge moderate (15 cm/yr); permeable unsaturated zone (gravelly sandy loam)
FE/USS/Fairless Hills, PA	High	Ground water shallow (4 m); recharge high (23 cm/yr); permeable unsaturated zone (sand and gravel)
FE/USS/Lorain, OH	Moderate	Ground water moderately deep (15 m); recharge low (8 cm/yr); very impermeable unsaturated zone (shale); APC dust/sludge managed in impoundment, which has standing liquid that provide a hydraulic head to drive contaminants into the subsurface
TI/DuPont/NewJohn., TN	High	Waste solids managed in impoundments, which have standing liquid that provide a hydraulic head to drive contaminants into the subsurface; ground water moderately deep (11 m); unsaturated zone impermeable (primarily silt and clay)
TI/SCM #1 and #2/Ashtabula, OH	High	Waste solids managed in impoundments, which have standing liquid that provide a hydraulic head to drive contaminants into the subsurface; ground water moderately shallow (6 m); impermeable subsurface (primarily silt and clay)
TI/Kerr-McGee/Hamilton, MS	High	Waste solids managed in impoundments, which have standing liquid that provide a hydraulic head to drive contaminants into the subsurface; ground water moderately shallow (6 m); permeable subsurface (primarily sand); modeling predicts contamination
TI/Timet/Henderson, NV	High	Waste solids managed in impoundments, which have standing liquid that provide a hydraulic head to drive contaminants into the subsurface; ground water moderately deep (12 m); permeable subsurface (primarily sand)
PA/Central/Plant City, FL	High	Observed contamination in surficial and upper Floridan aquifers attributed to gypsum stack and ponds
PA/CF Chemicals/Bartow, FL	High	Observed contamination in surficial aquifer attributed to gypsum stack and ponds; State has initiated enforcement action in response
PA/Mobil/Pasadena, TX	High	No observed contamination or damage case; ground water very shallow (2.5 m); impermeable subsurface (primarily clay); standing quantity of process wastewater provides a hydraulic head to drive contaminants into subsurface
PA/Arcadian/Geismar, LA	Moderate	Contamination in shallow (3 m) ground water attributed to gypsum stack and clearwell areas, but contamination likely to discharge directly into nearby river and usable aquifer deeper (55 m) and more protected

Exhibit E-3-1 (cont'd)
Ground-Water Contamination Potential of

Sites Modeled in the Cost/Economic Impact Analysis

Sector/Site	Ground-Water Contamination Potential	Rationale
PA/Royster/Mulberry, FL	High	Observed contamination in surficial aquifer attributed to gypsum stack and ponds; State has initiated enforcement action in response
PA/Agrico/Donaldsonville, LA	High	Observed contamination of shallow aquifer attributed to gypsum stack and ponds
PA/Conserv/Nichols, FL	High	Observed contamination in surficial aquifer attributed to gypsum stack and ponds; State has initiated enforcement action in response
PA/Agrico/Mulberry, FL	High	Observed contamination in surficial aquifer attributed to gypsum stack and ponds; State has initiated enforcement action in response
PA/U.S. Agrichem/Ft. Meade, FL	High	Observed contamination in surficial aquifer attributed to gypsum stack and ponds; State has initiated enforcement action in response
PA/Nu-West/Soda Springs, ID	High	Observed ground-water contamination due to dike failure and large spill; inconclusive data suggest that some leakage may be occurring presently
PA/Seminole/Bartow, FL	High	Observed contamination of surficial and deeper usable aquifers that is potentially attributable to gypsum stacks and associated ponds
PA/Gardinier/Riverview, FL	High	Observed contamination of surficial aquifer that is potentially attributable to the gypsum stack and process wastewater ponds
PA/Nu-South/Pascagoula, MS	High	Although no documented contamination or damage case, process wastewater provides a hydraulic head that may drive contaminants to the subsurface; ground water very shallow (1.5 m); subsurface permeable (primarily sand)
PA/Texasgulf/Aurora, NC	High	Observed contamination in surficial and usable intermediate aquifer attributed to process wastewater ponds; although dike failure at gypsum stack has resulted in large spills of wastewater, the gypsum stack is not clearly implicated as a source of continuing ground-water contamination
PA/Chevron/Rock Springs, WY	Low	No documented contamination or damage case; ground water very deep (122 m); subsurface a fractured shale that is generally impermeable, although contaminants could readily migrate in fractures; process wastewater provides a hydraulic head that could drive contaminants to the subsurface, but natural recharge very low (<1 cm/yr) and leaching from dried gypsum very unlikely
PA/IMCFert./Mulberry, FL	High	Observed contamination of surficial and usable Floridan aquifers attributed in part to the gypsum stack and associated ponds
PA/Royster/Palmetto, FL	High	Observed contamination in surficial aquifer potentially attributed to gypsum stack and associated ponds; State has initiated enforcement actions in response

Exhibit E-3-1 (cont'd)
Ground-Water Contamination Potential of
Sites Modeled in the Cost/Economic Impact Analysis

Sector/Site	Ground-Water Contamination Potential	Rationale
PA/Agrico/Uncle Sam, LA	High	Documented site contamination that may be partly due to phosphogypsum and process wastewater management units; ground water shallow (3 m); subsurface relatively impermeable (primarily clay and silt); process wastewater provides a hydraulic head to drive contaminants into subsurface; natural recharge that seeps through dried gypsum very low (2.5 cm/yr)
PA/Farmland/Bartow, FL	High	Observed contamination in surficial aquifer that may be attributed to phosphogypsum and process wastewater management units; State has initiated enforcement action in response
PA/J.R. Simplot/Pocatello, ID	High	Process waste water provides a hydraulic head that may drive contaminants to the subsurface; ground water moderately shallow (9 m); subsurface very permeable (primarily sand and gravel); natural recharge available to seep through dried gypsum very low (1 cm/yr)
PA/Occidental/White Springs, FL	High	Process waste water provides a hydraulic head that may drive contaminants to the subsurface; ground water moderately deep (14 m); karst terrane may allow contaminant transport in solution cavities; high natural recharge (30 cm/yr) available to seep through any dried gypsum

At present, some generators of special mineral processing wastes ship their waste(s) off-site for disposal. Under the Subtitle C-Minus scenario, as for the other scenarios considered in this analysis, EPA has assumed that this practice will continue if on-site management is more expensive than off-site disposal. Candidate Subtitle C wastes managed off-site, however, are assumed to be sent to facilities that comply with all provisions of Subtitle C, i.e., the facilities that receive such wastes do not receive the flexible management standards that apply to on-site management under Subtitle C-Minus. All other assumptions made for the full Subtitle C regulatory scenario with respect to the choice of waste management technologies apply to the Subtitle C-Minus regulatory scenario as well.

Subtitle D-Plus Program Scenario

The third and final regulatory alternative considered by the Agency for this analysis of regulatory costs and impacts is regulation under one possible approach to a RCRA Subtitle D program tailored to address the special characteristics of large volume mineral processing wastes. The Agency could consider applying such a Subtitle D program to any of the 20 mineral processing wastes subject to this study that are permanently excluded from regulation under RCRA Subtitle C.

Substantively, this approach would be a state-implemented program based on a minimum set of federal technical criteria and provisions for state program primacy. The technical criteria contained within the hypothetical Subtitle D-Plus program consist essentially of provisions for the state establishment of media-specific performance standards for ground water, surface water, air, and soils/surficial materials. It would also establish technical criteria for a variety of required owner/operator activities, including design and operating

Exhibit E-3-2
Design and Operating Criteria, and Other Requirements
Under the Subtitle C- Scenario

Waste Management Practice	Ground Water Exposure/Risk Potential		
	Low	Moderate	High
Waste Pile Disposal	Current Liner Configuration Ground-Water Monitoring Soil/Rock Cap, Regrade as Necessary	Not Allowed	Not Allowed
Surface Impoundment Disposal	Current Liner Configuration Ground-Water Monitoring Soil/Rock Cap	Composite Liner (new unit) Ground-Water Monitoring Composite Cap/Run-off Collection	Composite Liner (new unit) Ground-Water Monitoring Composite Cap/Run-off Collection
Surface Impoundment Storage/Treatment	Current Liner Configuration Ground-Water Monitoring	Composite Liner (new unit) Ground-Water Monitoring Clean Closure	Composite Liner (new unit) Ground-Water Monitoring Clean Closure
Landfill Disposal	Current Liner Configuration Ground-Water Monitoring Soil/Rock Cap	3-ft. Thick Clay Liner (new unit) Ground-Water Monitoring Composite Cap/Run-off Collection	Composite Liner/Leachate Collection (new unit) Ground-Water Monitoring Composite Cap/Run-off Collection
Gypsum Stack Disposal	Current Liner Configuration Ground-Water Monitoring	Composite Liner/Leachate Collection (new unit) Ground-Water Monitoring Composite Cap/Run-off Collection	Double Composite Liner/Leachate Detection (new unit) Ground-Water Monitoring Composite Cap/Run-off Collection

criteria, monitoring criteria, corrective action requirements, closure and post-closure care criteria, and financial responsibility requirements.

In addition, the program would require the periodic characterization of regulated materials and a number of general and location-specific analytic studies designed to ensure that regulated materials management and closure activities are adequately protective of human health and the environment. Specific operating and closure requirements (e.g., the use of liners, placement of caps), however, are left in large part to the discretion of the states. Because this would be a Subtitle D program that is similar in many respects to current state Subtitle D solid and industrial waste regulatory provisions, and because the program would give considerable flexibility to the states regarding the application of specific waste management and closure requirements, EPA anticipates that the incremental requirements of the program above baseline conditions would in many cases be minimal.

Design and Operating Criteria

For this analytical scenario, EPA established a variety of design and operating criteria, including structural stability requirements, requirements applicable to land application activities and for the protection of biological resources, and location-specific criteria for units located in floodplains, seismic impact zones and unstable/fault areas, Karst Terrane, and wellhead protection areas (as defined by states pursuant to Safe Drinking Water Act requirements). The state also would have the flexibility to establish unit-specific requirements by rule or guidance. Owner/operators would have to follow management practices specified by the state for any unit for which media-specific performance

standards are established by the state (based on the regulated materials characterization) in order to ensure compliance with those performance standards.

EPA believes that, aside from analytic studies required as part of the location-specific criteria and periodic inspections by third parties for structural stability, many of the requirements that would apply under the Subtitle D-Plus scenario are in fact currently required under existing state regulatory programs. In order to estimate the incremental costs of this regulatory alternative's design and operating criteria, therefore, the Agency used empirical data and best professional judgment to calculate the costs of such analytic studies.

The Agency has applied the Subtitle D-Plus scenario design and operating criteria in much the same way as it has the analogous requirements of the Subtitle C-Minus scenario, i.e., on a risk-based, site-specific basis. EPA has used the risk potential categories described above (see Exhibit E-3-1) to establish the standards that apply to waste management units under the Subtitle D-Plus scenario for each potentially affected facility. The specific requirements that apply for each category and waste management technology are presented in Exhibit E-3-3. It is important to note that with the exception of sites in the "low" risk potential category, facilities would be required to manage the special wastes in lined waste management units; in most instances, this implies construction of new units, rather than continued use of existing units. Consequently, for many facilities, the difference between the Subtitle C-Minus and Subtitle D-Plus scenarios is minimal, in terms of the activities (and associated costs) that would be mandated under these two regulatory alternatives.

Monitoring

Under the Subtitle D-Plus scenario, owner/operators would have to establish ground-water, surface water, and/or air monitoring systems for any units for which ground-water, surface water, and/or air performance standards, respectively, are established by the state. Unlike Subtitle C, however, this approach would provide for demonstrations by the owner/operator that management practices adequately isolate and contain the waste(s) so that a release of hazardous constituents would not occur. The program would, in fact, encourage the adoption of such management practices in lieu of the establishment of monitoring systems. EPA believes that, if this management practices approach were not adopted, then the monitoring requirements established by the state would essentially equate to monitoring requirements provided for under current regulation. In order to estimate the incremental monitoring costs of the Subtitle D-Plus approach above baseline, therefore, EPA calculated for each waste stream the cost of management practices that could be used to isolate and contain the waste and/or the cost of demonstrating that such management practices would warrant the waiver of monitoring requirements. The Agency believes, however, that only facilities having a "low" risk potential would be able to demonstrate isolation/containment and therefore be eligible for a waiver of the requirements; facilities in the "moderate" and "high" risk potential categories would be required to conduct monitoring (including ground water monitoring) in all cases

Corrective Action

The corrective action provisions established under the Subtitle D-Plus scenario are essentially the same requirements made under current Subtitle C regulation. The principal difference between the two programs is that Subtitle D-Plus corrective action requirements would apply only to releases from regulated units and not to all other waste management units within the facility boundary. Therefore, in the event that the Subtitle D-Plus program described here were to be promulgated, corrective action costs would be the same, or quite possibly lower, than Subtitle C corrective action costs. In addition and as discussed above, the Agency does not believe that accurately estimating corrective action costs for this study is tractable, nor would it be likely to significantly change the findings or implications of this report. As a result, EPA has not estimated corrective action costs for the Subtitle D-Plus scenario.

Exhibit E-3-3
Design and Operating Criteria, and Other Requirements
Under the Subtitle D-Plus Scenario

Waste Management Practice	Ground Water Exposure/Risk Potential		
	Low	Moderate	High
Waste Pile Disposal	Current Liner Configuration	Concrete Liner (new unit) Leachate/Run-off Treatment Ground-Water Monitoring	Concrete Liner (new unit) Leachate/Run-off Treatment Ground-Water Monitoring Composite Cap/Run-off Collection
Surface Impoundment Disposal	Current Liner Configuration	Composite Liner (new unit) Ground-Water Monitoring Composite Cap/Run-off Collection	Composite Liner (new unit) Ground-Water Monitoring Composite Cap/Run-off Collection
Surface Impoundment Storage/Treatment	Current Liner Configuration	Composite Liner (new unit) Ground-Water Monitoring Clean Closure	Composite Liner (new unit) Ground-Water Monitoring Clean Closure
Landfill Disposal	Current Liner Configuration	3-ft. Thick Clay Liner (new unit) Ground-Water Monitoring Composite Cap/Run-off Collection	Composite Liner/Leachate Collection (new unit) Ground-Water Monitoring Composite Cap/Run-off Collection
Gypsum Stack Disposal	Current Liner Configuration	3-ft. Thick Clay Liner (new unit) Sand Layer/Geotextile Leachate/Run-off Treatment Ground-Water Monitoring	Composite Liner (new unit) Leachate/Run-off Collection and Treatment Ground-Water Monitoring

Closure and Post-Closure Care

The closure and post-closure care provisions of EPA's Subtitle D-Plus approach, as with the rest of the program, would allow considerable flexibility to the states in establishing the specific requirements applicable to owner/operators. EPA believes that states would, in some cases, require closure and post-closure care activities that are similar to those established under Subtitle C programs. Cases where this approach would likely apply include the closure of surface impoundments and tank treatment systems. Such activities might include the removal of wastes, decontamination of soils and equipment, and/or the installation of rock caps or soil caps with revegetation. For waste piles and landfills, states would likely require actions designed to stabilize, isolate, and contain wastes, such as chemical fixation to control wind dispersal, permanent run-on/run-off controls, and neutralization to immobilize metals. EPA believes that the removal of materials from large waste piles or landfills, or the retrofitting of liners, would not be required. Post-closure care would apply to any unit containing special wastes after closure and consist of periodic inspections and the maintenance of run-on/run-off controls, site-access controls, and other ongoing closure activities for a period of 30 years.

Data gathered from the 1989 SWMPF Survey suggest that in general, owner/operators are not currently facing state-imposed closure or post-closure care requirements. The application of the Subtitle D-Plus program to mineral processing wastes, therefore, would impose incremental costs above the baseline. EPA believes that these costs would resemble those incurred under the Subtitle C scenario, and hence has computed them in the same manner, accounting fully for differences in final cover material, monitoring requirements, etc. In addition, EPA estimated the present value

cost of preparing closure and post-closure care plans based on typical costs for such plans under Subtitle C requirements.

Financial Responsibility

The financial responsibility provisions established by the prospective Subtitle D-Plus program are the same as the provisions established under Subtitle C, including coverage for source control and remediation of known releases (i.e., corrective action), coverage for closure and post-closure care, and Environmental Impairment Liability (EIL) coverage (i.e., for third-party damages).

2. Cost Model Development

Conceptual Waste Management Practices

The three alternative regulatory scenarios considered in this report are based upon Subtitle C of RCRA, a "Subtitle C-Minus" alternative based upon RCRA §3004(x), and a site-specific, risk-based Subtitle D-Plus approach. For each alternative scenario, EPA has considered the appropriate legal requirements (described in the preceding section), and the physical and chemical characteristics and generation rates of each waste stream analyzed, as well as the technical feasibility of implementing particular waste management technologies or treatment trains. The result is a well-defined, and quite limited, set of management practices that are available to facility operators generating one or more of the special mineral processing wastes. Not surprisingly, the options under the full Subtitle C scenario are more limited both in number and in the manner in which they can be employed than the options available under the other alternative regulatory scenarios. The management options that the Agency believes would be available and feasible within each of the regulatory alternatives are described in the following paragraphs.

Subtitle C

Because of the physical/chemical nature of the special mineral processing wastes and the strict technical standards of Subtitle C, EPA has identified only four primary ways of disposing of the special mineral processing wastes: solids must go to landfill disposal, sludges/slurries generally report to surface impoundment storage/stabilization/disposal system, slurried solids (e.g., phosphogypsum) go to a disposal impoundment, and wastewaters are subjected to tank/surface impoundment treatment, then discharged or recycled. Because all of the wastes of interest are inorganic, other types of technologies (e.g., incineration, solvent recovery) are unavailable. Wastes can also be recycled or recovered, in addition to being disposed or treated. Under Subtitle C, permanent disposal of material in waste piles is not permitted, though these units may be used for storage. All land-based units, whether they are used for storage, treatment, or disposal, must contain impermeable liners, have leachate collection systems, and meet other technical standards, such as closure requirements. Hence, units such as gypsum stacks are not allowed under the Subtitle C scenario.

Subtitle C-Minus

Section 3004(x) of RCRA allows the EPA Administrator to relax certain Subtitle C requirements for landfills and surface impoundments, i.e., other types of units are ineligible for modified requirements. Among the HSWA requirements that may be relaxed are the prohibition on placing liquids in landfills, requirements specific to interim status surface impoundments, corrective action requirements for continuing releases, the Land Disposal Restrictions (LDRs), and the minimum technical standards that apply to new land disposal units (e.g., landfills, surface impoundments).

In EPA's view, only the last two of these provisions have much conceptual significance to the Report to Congress, because: 1) liquids in landfills is an unimportant issue because of the nature of the wastes in question (sludges will report to surface impoundment or landfill disposal, depending upon moisture content); 2) the interim status

provisions have expired (as of 1988); and 3) as discussed above, most of the facilities of interest are already subject to Subtitle C corrective action provisions.

Relaxation of the minimum technical standards, on the other hand, implies some important changes to the ways in which special wastes may be managed. For example, units may be lined with clay rather than two synthetic liners, and may be closed without installing a RCRA Subtitle C cap. As a consequence, waste management costs would be reduced, though the types of waste management practices that are technically feasible under this scenario generally parallel those that would be available under the full Subtitle C scenario.

One important exception to this is that gypsum stacks would be allowed under Subtitle C-Minus, though in significantly altered form. Subtitle C-Minus gypsum stacks that would be located in "moderate" or "high" risk potential areas would be required to have single and double synthetic liners, respectively, as well as leachate collection and ground-water monitoring systems. In addition, these units would need to be capped at unit closure with a composite (clay/synthetic) cap, run-off collection system and soil or rock cap. To accomplish this, the shape of gypsum stacks would have to change dramatically. Rather than the steep sides that characterize most existing stacks, side slopes on Subtitle C-Minus gypsum stacks could not exceed a slope of three to one (approximately 18 degrees), so as to enable the operator to emplace and maintain the cap at closure. As a result, new gypsum stacks that would be constructed under this scenario would require far more land area for disposal of a given quantity of gypsum than conventional stacks. Because most of the major capital and operating costs of land disposal are a function of area, this difference implies major impacts on waste management costs at affected facilities.

As discussed above, the Land Disposal Restrictions program would not immediately apply to any of the 20 special wastes if they were to be removed from the Mining Waste Exclusion. Nonetheless, EPA did include an extra step in the full Subtitle C costing scenario to account for a plausible means of achieving the objectives of the LDRs for sludge materials (cement stabilization). In the Subtitle C-Minus scenario, however, the assumption that EP toxic sludges would need to be cement-stabilized prior to land disposal has been relaxed, resulting in a significant decrease in the total cost of managing these wastes, as compared to full Subtitle C.

Subtitle D-Plus

The conceptual Subtitle D-Plus program for mining and mineral processing wastes is a site-specific, risk-based approach for controlling environmentally significant releases from waste management units. Under this scenario, waste streams are evaluated on a facility-specific basis, in much the same way as they are under the Subtitle C-Minus scenario:

- If the waste does contain constituents of concern for a particular pathway but the facility is located in a setting with "low" risk potential, the operator may demonstrate that his management practices (current or prospective) limit releases sufficiently to eliminate any potential risk. In such cases, the operator may comply with program requirements by "adding on" to existing waste management controls, rather than by constructing new waste management units. For example, wastes that contain chromium in sufficient concentrations to pose risk through entrainment of waste dust and downwind exposure to humans may be controlled by use of dust suppression techniques without triggering the full array of Subtitle D-Plus program requirements. Thus, under the Subtitle D-Plus scenario, wastes that exhibit characteristics of hazardous waste may continue to be managed as they are currently, though some additional control measures may be required (e.g., run-on/run-off controls, dust suppression).
- In cases where the risk potential is "moderate" or "high," the other aspects of the program are applicable. These include design and operating criteria, monitoring, closure and post-closure care requirements, and financial responsibility provisions, as described in the previous section. Because most facilities considered in this report are not in compliance with these criteria, most facilities for which risk potential is moderate or high would have to construct new units if this scenario were to be applied.

Components of the Cost Model

EPA's cost estimating model has two major components: design modeling and cost estimation. For any type of waste management practice, it is first necessary to calculate the capacity (physical volume for disposal units and throughput for treatment units) that will be required to manage the waste(s) of interest. Then the model moves to the second component, which involves assembling the various cost elements that in combination comprise a waste management practice, and estimating the cost associated with each element. Because different elements are in reality a function of different input variables, and because the elements of interest vary between facilities and among scenarios, the Agency's modeling approach yields a more realistic view of both current and alternative waste management costs than simple, aggregated cost modeling functions.

Design Model

For wastes that are assumed to be managed in land-based units (e.g., landfills, surface impoundments), the first step in evaluating waste management costs is to determine the capacity and dimensions of the waste management unit. The size of the unit is dependent on four user-supplied (in this case, site-specific) variables: waste generation rate, the percent of solids contained in the waste (for liquids and sludges), the settled density of these solids (if applicable), and unit operating life. Based on these factors, the model will calculate the dimensions of a unit large enough to accommodate the predicted accumulation of waste or treatment residue over the operating life of the unit (15 years for disposal units). In the case of surge ponds (i.e. storage surface impoundments, the necessary capacity (throughput) is calculated based upon a retention time of one day, i.e., the capacity is one-365th of the annual waste generation rate for a wastewater with low solids content. In the case of storage waste piles, the necessary capacity (throughput) is calculated based upon a retention time of one week.

Dimensions are based on the assumption that land-based units are square, and are constructed by excavating the interior and using the material removed to construct berms along each edge. Berms are built with a three-to-one slope both inside and outside, and have a flattened top that varies in width with the size of the unit; small units have a berm wide enough to walk on and visually inspect (six feet), while larger units have progressively wider berms (up to 40 feet) so as to enable vehicles to traverse the top (moderately large units) or cranes to be placed on the top of the berm and excavate material from inside the unit (large units).

For this analysis, EPA has made the assumption that all new units are constructed on-site, i.e., facilities currently have enough land to construct new units of adequate size. This implies that wastes will not have to be transported significant distances prior to disposal, and that facilities will not need to purchase additional land at current market prices (though there is an opportunity cost). The Agency has captured the opportunity cost by including a nominal land cost in calculating the cost of the unit; the number of acres required exceeds the area of the unit by approximately 20 percent, to allow for a buffer zone. This approach and its underlying assumptions are based on review of responses to the National Survey, and personal observations made during EPA visits to numerous mineral processing facilities.

The design modeling process yields a number of unit dimensions and other data that serve as inputs to the cost element equations. Some costs are a function of the total area of the unit, while others are directly related to the interior surface area of the unit, unit perimeter, and/or other variables.

Costing Model

Once the dimensions of the unit have been specified, the cost of each required element is calculated, based upon one or more of these dimensions. Individual element costs are summed to yield the total cost of the management practice. The specific elements that are required for a given practice depend upon the type of unit(s) employed and the requirements of the regulatory scenario being examined. Scenarios contain both general and unit-specific components, which are discussed in the following paragraphs.

General Components. For each regulatory scenario, EPA has made provisions for any cost that would be required of the facility operator either at the facility level or that applies equally to any type of waste management unit. Examples of these general cost components include (to a first approximation): permitting, financial assurance, and site security.

Unit-Specific Components.

- **Landfills**-The conceptual landfill that the Agency has developed is a large monofill that is fully constructed in the first year, receives material continuously throughout its operating life (does not have individual cells), and is closed with a cap and cover that encloses the entire unit upon closure. EPA selected this design because it has the lowest cost (greatest capacity for a given area, lowest permitting cost, etc.), and because there is no requirement (even under Subtitle C regulations) for individual cell construction or annual cell closure.
- **Surface Impoundments**-Surface impoundment construction closely parallels that of landfills. Disposal surface impoundments are assumed to fill up and require closure at the end of the operating life; these units are closed in the same way as landfills (for a given scenario).
- **Waste Piles**-These units do not require excavation, but do require liners or bases and covers under some scenarios. Storage waste piles require at least annual turnover of inventory and must be clean closed.
- **Gypsum Stacks**-Gypsum stacks are represented as a waste pile topped with an unlined surface impoundment. The cost of constructing and operating the stack includes a component for the gypsum slurry pipeline. Under the Subtitle D-Plus scenario, these units are assumed to be lined with clay, while under the Subtitle C-Minus scenario, stacks are lined with one or more synthetic liners, depending upon site-specific risk potential (gypsum stacks are not allowed under the full Subtitle C scenario).
- **Tank Treatment**-EPA has relied upon previous analytical work in developing costs for tank treatment of hazardous wastewaters. The Agency believes that these existing equations are valid within the entire range of waste generation rates considered in this report, and hence, do not require modification for this analysis.
- **Off-Site Disposal/Utilization**-EPA has incorporated a simple per-ton cost for disposing wastes and treatment residues off-site in either Subtitle C or D landfills into the cost model. Unit costs for off-site disposal of wastes are based upon recent contacts with commercial landfill operators. The Agency does not have adequate data to ascribe costs or credits associated with manufacturing and selling waste-related products; consequently, no such costs/credits have been built into the model.

Application to Special Mineral Processing Wastes

In this section, EPA describes the way in which specific waste streams have been assigned to management trains/technologies for each scenario of interest, some of the region- and site-specific flexibility that the Agency has built into the costing model, and the analytical assumptions that have been used in conducting the cost modeling runs.

Assignment of Waste Streams to Management Trains/Technologies

Waste streams are first identified as candidates for regulation under a particular scenario on the basis of chemical characteristics and, for the Subtitle D-Plus scenario, on a site-specific evaluation of current waste management practices. Wastes that exhibit one or more characteristics of hazardous waste are assumed to be candidates for regulation, at the facilities at which EPA's data indicate that the waste may be hazardous. Facilities for which waste constituent data are unavailable are generally assumed to pass the criteria that apply to each scenario, with certain sector-specific exceptions.

Subtitle C

Under the Subtitle C scenario, solid materials (copper, lead, and zinc slags, iron/steel APC dust/sludge) are managed in Subtitle C landfills. Slurried solids (phosphogypsum) are managed in Subtitle C disposal surface impoundments (disposal surface impoundments must comply with landfill closure requirements). Sludge and sludge solids (titanium tetrachloride waste solids, calcium sulfate WWT sludge) are settled in storage/treatment impoundments, cement stabilized, then disposed in Subtitle C landfills. Wastewaters containing small amounts of suspended/dissolved solids (phosphoric acid, hydrofluoric acid, and magnesium process wastewaters) are collected in small surge ponds, managed in treatment tanks for pH adjustment, and then routed to their current points of storage, reuse, or discharge. Sludges from this tank treatment are assumed to be non-hazardous and are disposed in a Subtitle D monofill.

Subtitle C landfills and surface impoundments are constructed using two liners with leachate collection systems above and between them, a geosynthetic membrane above the upper leachate collection system, ground-water monitoring systems along the downgradient edge (half the perimeter) of each unit, and run-on and run-off controls. EPA's run-on/run-off control equations account for whether a facility is located in a floodplain, in which case surface water control is more difficult and expensive. At closure, these units are capped with a composite liner and either a layer of clay covered with topsoil or a layer of sand with a leachate collection system and a rock cap, depending upon the region in which the facility of interest is located (as discussed more fully below).

Subtitle C-Minus

Under the Subtitle C-Minus scenario, wastes are generally managed using the same technologies as under Subtitle C, but the design requirements that apply to the units themselves are far less stringent. Section 3004(x) of RCRA allows for the relaxation of the HSWA minimum technical standards for landfills and surface impoundments, as discussed above. Accordingly, EPA has assumed that some of the more complex and expensive requirements would be modified under this scenario. The primary differences involve use of single clay/synthetic liners (except in the case of gypsum stacks located in high risk areas) rather than the double synthetic liner/leachate collection system and synthetic/clay/topsoil cap configurations required under full Subtitle C. Most other Subtitle C requirements (e.g., permitting, financial assurance, ground-water monitoring) apply in full in this scenario. As discussed above, modified gypsum stacks are allowed under the Subtitle C-Minus scenario. Cement stabilization of sludges is not required; sludge, therefore, is disposed in a disposal surface impoundment.

Subtitle D-Plus

The Subtitle D-Plus scenario allows for more flexibility on the part of the operator than either of the Subtitle C scenarios. Facility operators may use or adapt existing waste management technologies (e.g., disposal waste piles) in more situations than they can under the Subtitle C-Minus scenario. Under this scenario, EPA has assumed that any facility that manages a waste that contains constituents of concern would first attempt to institute a constituent control mechanism to reduce or prevent releases (e.g., run-on/run-off controls, dust suppression). This strategy could be effective if the potential pathway(s) of concern involved air or surface water, but would be insufficient if there is a moderate or high potential threat via ground water at

a given site. In that case, requirements for a containment system (i.e., liner), ground water monitoring, and the other aspects of the full Subtitle D-Plus program would be triggered.

The sectors and facilities that generate one or more wastes that may exhibit EP toxicity or corrosivity or have resulted in documented damages are analyzed using the model. Facilities generating wastes that do not contain constituents of concern are subject only to periodic waste testing and waste management structural stability requirements; EPA has computed the more or less fixed, constant, and modest costs associated with these requirements outside the cost model itself. Cost model input data files contain variables that indicate the pathway(s) that may be of concern for a given facility; these data are based directly on the descriptive risk analyses that the Agency developed for the risk assessment portion of this report. If these data indicate that only air and/or surface water pathways are important (i.e., low ground water risk potential), then the model calculates the cost of the necessary dust suppression

measures run-on/run-off controls, as well as the waste testing and structural stability studies that apply to all facilities under this scenario. For facilities at which potential ground-water contamination is an issue, the model computes the cost of constructing a new landfill, surface impoundment, or gypsum stack containing a single clay or composite liner, or a treatment tank, ground-water monitoring (if applicable), closure costs (composite and soil or rock cap for land disposal units), and financial assurance costs (Note: as discussed above, corrective action costs have not been estimated). Wastes are assumed to be managed in the same manner as they are currently.

One highly significant difference between this scenario and the other two is that under the Subtitle D-Plus program, EPA has assumed that wastes can be sold and used off-site without further processing, e.g., slags could be crushed and sized, then sold for use as road base or construction aggregate. The Agency's data indicate that this constitutes current practice for some wastes at some facilities (i.e., baseline). In these cases, EPA has ascribed current management costs associated with storage, but not for disposal, and has applied this same assumption for the Subtitle D-Plus scenario, i.e., incremental compliance costs for facilities that sell all of their special waste(s) are assumed to be zero under the Subtitle D-Plus program.

Regional/Site Variability

In evaluating the management strategies that would be applied to the special mineral processing wastes under various regulatory scenarios, it is important to consider the substantial variability that exists from site to site with respect to environmental conditions and to the availability of natural materials that may be needed for waste management unit construction. These regional and state-level variations have been taken into consideration in building and applying the cost model, and work in two basic ways: one is in determining the requirements that apply to a given site and the other is in specifying the availability and cost of materials needed to employ a given waste management technology (these two factors are in some cases related).

Waste management requirements are influenced by factors such as net precipitation (i.e., leachate generation potential) and proximity to sensitive environments, such as wetlands. Under all three scenarios, for example, land disposal unit cover requirements are different for facilities in arid areas than they are for facilities located in other areas; landfills and surface impoundments located in the Southwest (e.g., Arizona) are assumed to be capped with a synthetic liner/leachate collection and removal system/rock cap rather than the synthetic liner/clay layer/drainage layer/soil cap required in other areas of the country.

In addition, the techniques and associated costs that are applied to a particular facility are affected by existing regulatory requirements and activities. Facilities that are already permitted Subtitle C Treatment, Storage, and Disposal Facilities (TSDFs) experience only a relatively modest (25 percent of new permit cost) incremental cost associated with opening a new unit rather than the significant permitting costs associated with entering the Subtitle C system for the first time.

Facility location affects material costs in a very direct way if a given scenario requires the installation of a new waste management unit. New units, even under the Subtitle D-Plus scenario, require clay liners, and under the more stringent scenarios, sand layers containing leachate collection systems between liners. In areas where natural clay and/or sand is scarce, this may involve a significant differential cost. EPA has identified the areas (states) in which these materials are not naturally abundant and has factored the extra cost involved in obtaining and transporting them to the site into the cost model. The Agency has assumed that there are no regional cost differentials that apply to man-made materials (e.g., synthetic liner, geosynthetic filter fabric), or to the cost or availability of off-site disposal capacity (for both hazardous and non-hazardous wastes).

Analytical Assumptions

The final step in developing the cost modeling approach is to specify the analytical assumptions that will be applied. Many such assumptions are required, and may affect the outcome of the analysis in significant ways. Wherever possible, EPA has attempted to make important assumptions an input to the cost modeling process, rather than imbed

them in the cost modeling computer code. The necessary assumptions and EPA's selected values for numerical variables are presented in the following series of bullets.

- **Operating Life.** EPA has assumed that all new waste management units will be operated (receive wastes) for a period of 15 years, after which they will be closed/dismantled. For the baseline scenario, the Agency has calculated the cost of current waste management, considering specific controls that may be employed at a particular site (e.g., run-on/run-off controls, ground water monitoring), as well as the expected life of the unit (units projected to close in the near term are replaced in the baseline scenario). For analytical purposes, EPA has assumed that facilities will operate for only the next 15 years. It is worthy of note that after one operational cycle, costs associated with constructing new units will be negligible (in comparison with current costs) at the significant and positive discount rates that have been used in this analysis.
- **Tax Rate.** In order to capture the true cost to the affected firms, EPA has conducted this analysis on an after-tax basis, and has employed a uniform assumption of the maximum federal corporate income tax rate (34.5 percent).
- **Discount Rate.** EPA has used the results of previous work² to develop weighted average cost of capital estimates. For this analysis, the Agency has used the overall estimate for all affected industries. In addition, EPA has employed the assumption that affected firms would finance new waste management activities with a combination of debt and equity such that their capital structure remains unchanged, and thus, have the same weighted average cost of capital after compliance as they did prior to the imposition of new regulatory requirements.
- **Inflation Rate.** EPA has conducted this analysis in real terms, i.e., using an inflation rate of zero. This makes the analysis computationally simpler, provides less opportunity for errors in calculation and interpretation, and eliminates the need to make an assumption about a factor that cannot be predicted with any confidence.
- **Sunk Capital.** The Agency has employed the assumption that all of the costs of capital construction of waste management units in the baseline case are unavailable to the firm (i.e., are sunk) as it responds to new regulatory requirements, except if the firm expects to replace its unit(s) during the time horizon of the analysis. In these cases, EPA has incorporated the discounted costs of any new units that will be required in the near-term (as indicated in the SWMPF Survey) into its estimates of current (baseline) waste management costs.

²ICF Incorporated. 1990. Regulatory Impact Analysis for the Proposed Rulemaking on Corrective Action for Solid Waste Management Units (Draft). Prepared for Economic Analysis Staff, Office of Solid Waste, U.S. EPA. June 25.

Appendix E-4

Sources of Market and Financial Data

Appendix E-4

Sources of Market and Financial Data

EPA calculated ratios of estimated compliance costs to value of shipments and value added and the ratio of annualized incremental capital costs to annual sustaining capital expenditures using available industry data. As discussed above, the Agency developed separate compliance cost estimates for waste management under the Subtitle C, C-Minus, and D-Minus scenarios. EPA then divided these facility-level costs by the appropriate facility or company data to arrive at the three measures of economic impact.

In cases where the affected facility produces an intermediate product (e.g., blister copper, pig iron) EPA has used the market value (if available) or estimated transfer price in establishing the value of shipments, and has similarly utilized an estimate of value added that reflects production of the intermediate product. This situation occurs at only a few facilities in a small number of commodity sectors (e.g., the Asarco/Hayden and Phelps Dodge/Playas copper smelters, Asarco's Omaha (refinery) and East Helena (smelter) lead facilities).

To calculate value of shipments (VOS) in all sectors, EPA derived annual long-term production estimates for each facility from data supplied by the United States Bureau of Mines, EPA's 1989 SWMPF Survey, and the SRI Chemical Manufacturers Yearbook.¹ An EPA contractor, Charles River Associates (CRA), supplied estimated long-term (1995) prices for each commodity. EPA converted the estimated price per pound estimated by CRA to a price per metric ton by multiplying by 2,205. Value of shipments is simply the product of annual production and price.

CRA also provided estimates of value added for each sector in 1995. Value added is defined here as the difference between the price of the final mineral commodity and the price (market or transfer) of the mineral input commodity (e.g., ore concentrate, bullion). The Agency recognizes that a true measure of value added would also include the costs of other purchased process inputs (e.g., fuel, reagents), but has relied upon this more simple approach because of data limitations. The value added was estimated in terms of cents-per-pound. EPA converted the cents-per-pound figure into a percentage of value added for each commodity and applied it to each firm's value of shipments to derive a value added estimate. The Agency assumed that all firms within a sector would have a similar cost structure and, therefore, the same percentage of value added.

Investment expenditures for each sector were developed by CRA and reflect estimated sustaining capital costs for average facilities in each affected sector, expressed as annual investment per ton of product. In the lead sector, investments for Doe Run's Boss, MO plant were assumed to be zero because the plant is currently on stand-by status. In the titanium tetrachloride sector, EPA applied the percentage of capital spending to VOS for titanium metals to the Timet plant, while the capital spending to VOS for titanium dioxide was applied to all other plants in the sector.

¹ 1987 Minerals Yearbook, U.S. Bureau of Mines, 1988; Mineral Commodity Summaries 1989, U.S. Bureau of Mines, 1989; 1987 Directory of Chemical Producers, SRI International, 1987.

Appendix E-5

Results of Financial Impact Analysis